Univerza v Mariboru
University of Maribor

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION	
Predmet:	Realna algebraična geometrija
Subject Title:	Real algebraic geometry

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Matematika		1	1 ali 2
Mathematics		1	1 or 2

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60					240	**10**

Nosilec predmeta / Lecturer: Igor Klep

Jeziki / Languages:	Predavanja / Lecture:	Slovenski / Slovene
	Vaje / Tutorial:	Slovenski / Slovene

Pogoji za opravljanje študijskih obveznosti:

Poznanje osnovnih pojmov iz algebre.

Prerequisites:

Knowledge of basic concepts from algebra.

Vsebina:

Realna algebraična geometrija preučuje semialgebraične množice, ki so rešitve končnih sistemov polinomskih enačb in neenačb (v več spremenljivkah, z realnimi koeficienti). Obravnavali bomo naslednje teme:

- urejeni obsegi, realno zaprti obsegi;
- *princip Tarskega*, ki pravi, da je projekcija semialgebraične množice vedno semialgebraična množica;
- strukturni izrek za semialgebraične množice, ki mu pravimo *Cilindrična algebraična dekompozicija*. Posledica tega izreka je, da so semialgebraične množice triangularizabilne;
- algebraične karakterizacije polinomov, ki so pozitivni oziroma nenegativni na dani bazični semialgebraični množici ter njihovo uporabo v optimizaciji polinomskih funkcij.

Navedena literatura služi le kot osnova in je nadgrajena z bolj specializiranimi teksti.

Content (Syllabus outline):

Real algebraic geometry studies semialgebraic sets which are solution sets of polynomial equations and inequalities (in several variables with real coefficients). We will address the following topics:

- ordered fields, real closed fields;
- the Tarski principle, which says that a projection of a semialgebraic set is itself semialgebraic. We will also discuss important implications of this result;
- cylindrical algebraic decomposition which is a classification result for semialgebraic sets. In particular, it implies that the latter sets are triangularizable;
- algebraic characterization of polynomials that are positive or nonnegative or zero on a given semialgebraic set, and their use in the optimization of polynomial functions.

The literature cited generally serves as a base and is being upgraded with more specialized texts.

Temeljna literatura in viri / Textbooks:

- C. Andradas, L. Bröcker, J.-M. Ruiz, *Constructible sets in real geometry,* Ergebnisse der Mathematik und ihrer Grenzgebiete (3) , 33. Springer-Verlag, Berlin, 1996.

- J. Bochnak, M. Coste, M.-F. Roy, *Real algebraic geometry*, Ergebnisse der Mathematik und ihrer Grenzgebiete (3) 36. Springer-Verlag, Berlin, 1998.

- M. Coste, *Introduction to semialgebraic geometry*,   Dip. Mat. Univ. Pisa, Dottorato di Ricerca in Matematica, Istituti Editoriali e Poligrafici Internazionali, Pisa (2000), http://perso.univ-rennes1.fr/michel.coste/polyens/SAG.pdf.

- A. Prestel, C.-N. Delzell, *Positive polynomials*. From Hilbert's 17th problem to real algebra, Springer Monographs in Mathematics. Springer-Verlag, Berlin, 2001.

- C. Scheiderer, *Real algebraic geometry*, skripta, http://www.math.uni-konstanz.de/~scheider/vorles/0708ws/RAG.html

Cilji:

- študenta seznaniti z osnovnimi področji realne algebre in realne algebraične geometrije
- pripraviti podlago za poglobljeni študij posebnih področij iz algebre in algebraične geometrije;
- razvijati sposobnosti študenta za samostojno reševanje problemov in razumevanje zahtevnejših matematičnih konceptov.

Objectives:

- to get students acquainted with fundamental topics of real algebra and real algebraic geometry;
- to give students a basis for the advanced study of some special topics in algebra and algebraic geometry;
- to develop student's skills for solving problems and understanding deeper mathematical concepts.

Predvideni študijski rezultati:

Znanje in razumevanje:
- poznavanje in razumevanje osnovnih rezultatov realne algebre in realne algebraične geometrije;
- poznavanje algoritmičnih prijemov iz algebre in njihova implementacija..

Prenesljive/ključne spretnosti in drugi atributi:
- podlaga za raziskovalno delo na področju algebre;
- prenos in implementacija znanja iz algebre različna strokovna in znanstvena področja, kjer se uporabljajo algebraične metode.

Intended learning outcomes:

Knowledge and understanding:
- knowledge and understanding of basic results of real algebra and real algebraic geometry;
- knowledge and understanding of basic algorithmic approaches to algebra and their implementations.

Transferable/Key Skills and other attributes:
- a basis for research in area of algebra;
- implementation and knowledge transfer of statistical methods into different areas dealing with algebraic methods.

Metode poučevanja in učenja:

- predavanja;
- domače naloge;
- priprava seminarja;
- konzultacije;
- samostojni študij.

Teaching and learning methods:

- lectures;
- homework;
- seminar work;
- consultations;
- self-study.

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):	Delež (v %) / Weight (in %)	Assessment methods:
		Type (examination, oral, coursework, project):
• seminarsko predavanje;	**30 %**	• seminar talk;
• domače naloge;	**30 %**	• homework;
• ustni ali pisni izpit.	**40 %**	• oral or written examination.