

UNIVERSITY OF KRAGUJEVAC  
FACULTY OF SCIENCE



Analysis  
Approximation  
Applications

INTERNATIONAL MATHEMATICAL CONFERENCE

JUNE 21-24 VRNJAČKA BANJA

Analysis Approximation Applications

**BOOK OF  
ABSTRACTS**

**2023**

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FACULTY OF SCIENCE

INTERNATIONAL MATHEMATICAL  
CONFERENCE  
ANALYSIS, APPROXIMATIONS AND  
APPLICATIONS  
(AAA2023)

Dedicated to Academician Gradimir V.  
Milovanović on the occasion of his 75th  
anniversary

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June 21–24, 2023  
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# ORGANIZATION

## ORGANIZERS

### Faculty of Science University of Kragujevac

The *Faculty of Science* in Kragujevac was established as a branch of the Faculty of Science in Belgrade on October 16th 1972. On April 15th 1976, the branch evolved into an independent Faculty which, by merging with five other faculties and two institutes, became one of the founders of the University "Svetozar Marković", today the *University of Kragujevac*. The Faculty comprises the following organizational units:



- Department of Mathematics and Informatics,
- Department of Biology and Ecology,
- Department of Physics,
- Department of Chemistry,
- Chair of General Education Courses,
- Secretariat.

The faculty offers degrees at all three levels of study - Bachelor's, Master's, and Doctorate degrees. For 51 years, following both the development of science and education and the demands of labour market, we have been developing teaching excellence concurrently with the courses offered, and the value of our Faculty may be shown as the outcomes of our alumni who build their successful careers both here and around the world. The academic staff includes 134 teachers and teaching assistants, 100 of whom hold doctorates. This year, 1401 students are studying at the faculty at all degree levels, 117 of whom are doctoral students. Every year, we publish about 200 scientific papers in the most respected international scientific journals. Our faculty has gained a reputation in scientific research due to:

- numerous scientific projects,
- prestigious international scientific journal **MATCH** - *Communications in Mathematical and in Computer Chemistry* (In 2021, MATCH impact factor was 2.633.),
- editions of international monographs Mathematical Chemistry Monographs,

and two national scientific journals:

- *Kragujevac Journal of Mathematics*, and
- *Kragujevac Journal of Science*.

Teachers and associates of Faculty are also the authors of the wide array of monographs and textbooks. Apart from the Academic Departments, The Faculty of Science also encompasses two separate units that are both classrooms for our students and places for our fellow citizens and tourists to visit:

- Aquarium
- Botanical Garden.

We have established international scientific cooperation and, enhancing it further, we are dedicatedly engaged to promote science with all the surrounding countries: North Macedonia, Montenegro, Bosnia and Herzegovina, and Croatia. We have effective cooperation with Italy, Austria, Germany, Czech Republic, China, Spain, Turkey, Poland, Bulgaria, Hungary, Romania, France, Greece, the UK, Switzerland, Belgium, the USA, Egypt, Russia... Over 20 countries around the world! Our mission is to enable the highest academic standards and provide acquiring of distinguishably exceptional knowledge and skills through education, scientific research work and through participation in the development of academic and broader social community. Our vision is to make Faculty grow into modern European higher education institution recognized by both educational and scientific achievements and graduate students' accomplishments. Having been cherishing excellence in education and science, the Faculty tends to contribute not only to the change of comprehensive educational and economy ambience in Serbia but to the overall social development.

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## HOST CITY – VRNJAČKA BANJA

Known from antiquity as the favorite destination of aristocracy, Vrnjačka Banja (eng. Vrnjacka spa) is a health resort in the heart of Serbia, popular nowadays for its springs of water with healthy features.

Vrnjačka Banja was named after the village of Vrnjci where mineral springs were first discovered. It is located in Central Serbia, 200 kilometers south from the city of Belgrade, at forested slopes of mountain Goč and in valleys of the Vrnjačka river and the Lipovačka river.

It has mild continental climate, and it has seven mineral springs, four of which are used for balneological therapy. History says that these mineral springs were discovered in ancient history at the time when this area was populated by the Celtic tribe Scordisci.

Based on archaeological findings, we can say that these springs were used in ancient times and at hot mineral spring in Vrnjačka Banja Romans built the health resort *Aquae Orcinae*, visited both by legionnaires and aristocracy. The remains of antique pools and terms are preserved to this day.

According to a legend, its healing powers were well known to the Turks as well, as it is known that Turkish sipahi came here looking for a piece of heaven. Local people covered the springs with dirt attempting to hide them.

The modern history of Vrnjačka Banja begins in 1868, when Pavle Mutavdžić, the district chief in Kruševac of the time, formed an appro-

private Constitutive association together with some other people of high reputation.

They bought land, ground catchment was performed, a pool was built, and drinking fountains of hot and cold water were set.

In 1883 state ownership was declared, and the inaugural season was opened by the Serbian Prince Mihailo (1867) when the spa became an elite summer resort.

Hot and cold mineral springs, helped by modern medicine, are used for treatment of diseases of the digestive system, diabetes, kidney diseases and urinary tract diseases, cardio vascular diseases and many more. Mineral waters from Vrnjačka Banja are also recommended to healthy people due to their curative effects.

Vrnjačka Banja is one of the most visited spas in Serbia, but what it also offers are numerous possibilities for sports and recreation.

A *must see* event organized in Vrnjačka Banja is The Carnival of Vrnjci, and those who enjoy other kinds of festivities can visit The Film Script Festival, The Great Summer Film Marathon and The Great Poetic Meeting.

The Carnival of Vrnjci is held every July and gives you a chance to join numerous costume balls and see many interesting exhibitions, concerts and theatrical plays.

While staying in Vrnjačka Banja you should visit some of the medieval monuments located near the spa. The monasteries Studenica, Žiča, Gradac, Djurdjevi Stupovi and Sopoćani are situated along the valley of the Ibar river.

The unforgettable experience awaits you at the medieval cities and fortresses of Ras, Maglic and Koznik. The magnificent manor house Belimarković, including the museum of Vrnjačka Banja, enriches the beauties of this town.

How to get to Vrnjačka Banja?

If you are traveling from the direction of Belgrade, you can get to Vrnjačka Banja using the Belgrade–Kraljevo road or the Belgrade–Niš–Skopje highway via Pojate. The road is around 200 km long.

If you are coming by bus all the major cities have bus connections to Vrnjačka Banja. Also you can go to Kraljevo, and then take a local bus to the spa and the distance is 30 km.

## The set of anti-Gaussian quadrature rules and corresponding multiple orthogonal polynomials

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Laurie in ([1]) introduced anti-Gaussian quadrature rule, that gives an error equal in magnitude but of opposite sign to that of the corresponding Gaussian quadrature rule. Here, we consider a set of anti-Gaussian quadrature rules for the optimal set of quadrature rules in Borges' sense, with respect to the set of  $r$  different weight functions, as well as the corresponding class of multiple orthogonal polynomials. Also, we define the set of averaged quadrature formulas and give some numerical examples.

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