

# Sandeep Kumar Soni

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## Work

- **PMF University of Zagreb**

*Post.Doc.*

- Mentor: Marko Vrdoljak
- Co-mentor: Marko Erceg

Zagreb, Croatia  
Since June 2024

## Education

- **PMF, University of Zagreb**

*Ph.D. programme in Mathematics*

- Ph.D. courses: Analysis, PDEs, Pseudo-differential operators and microlocal analysis, Mathematical modeling, Semigroup theory and evolution partial differential equations

Zagreb, Croatia  
Dec 2019 - April 2024

- **TIFR Centre for Applicable Mathematics**

*Master of Science (M.Sc.) in Mathematics*

- Advisor: Praveen Chandrashekar
- Marks: 67.20 %

Bangalore, India  
July 15, 2017 to July 31, 2019

- **St. Columba's College, Hazaribag**

*Bachelor of Science (B.Sc.) in Mathematics (Hons.)*

- University name: Vinoba Bhave University (VBU), Hazaribag
- Marks: 75%

Jharkhand, India  
July 2013 to July 2016

- **St. Columba's College, Hazaribag**

*Passed 12th grade in non-medical Sciences*

- Jharkhand Academic Council (JAC), India
- Marks: 72%
- Subjects: English, Economics, Physics, Chemistry and Mathematics

Jharkhand, India  
May 2011 to May 2013

- **S.S. High School, Tandwa, Chatara**

*Passed 10th grade*

- Jharkhand Academic Council (JAC), India
- Marks: 77.8%
- Subjects: English, Hindi, Mathematics, Science, Social Science and Sanskrit

Jharkhand, India  
2010

## Research Interests

- Microlocal defect tools in partial differential equations
- Operator theory
- Friedrichs systems (symmetric positive systems)
- Kreĭn Space theory
- Partial differential equations
- Spectral theory
- Model order reduction
- Spectral geometry
- Pseudo-differential operators

## Publications or preprints

- *Classification of classical Friedrichs differential operators: One-dimensional scalar case*, Communications on Pure and Applied Analysis, 2022, 21 (10) : 3499-3527.  
<https://www.aims sciences.org/article/doi/10.3934/cpaa.2022112>
- *The von Neumann extension theory for abstract Friedrichs operators*, (accepted at ZAA),  
<https://arxiv.org/abs/2312.09618>
- *Friedrichs systems on an interval*, <http://arxiv.org/abs/2401.11941>
- Doctoral dissertation: *Classification of boundary conditions for Friedrichs systems*,  
<https://repozitorij.pmf.unizg.hr/islandora/object/pmf:12911>

## Presentations and Invited Talks

- **8th Croatian mathematical congress** University of Osijek  
*Non-stationary theory for skew-symmetric and abstract Friedrichs operators* July 2–5, 2024
- **Mini-courses in mathematical analysis** University of Padova, Italy  
*The von Neumann approach for positive symmetric systems* June 24–28, 2024
- **Doctoral dissertation** University of Zagreb  
*Classification of boundary conditions for Friedrichs systems* April 16, 2024
- **Seminar for optimization and applications** University of Osijek  
*A generalised von Neumann type decomposition in terms of Friedrichs systems* December 13, 2023
- **Seminar for differential equations and numerical analysis** PMF, Zagreb  
*The von Neumann's Extension Theory for Abstract Friedrichs Operators* December 4, 2023

- **7th Najman conference on spectral theory and differential equations** Brijuni, Croatia  
*Abstract Friedrichs operators and skew self-adjoint realisations* September 18-23, 2023
- **Ph.D. Topic** PMF, Zagreb  
*Classification of boundary conditions for Friedrichs systems* November 29, 2022
- **Horizons in non-linear PDEs** ULM, Germany  
*Classical Friedrichs operators in 1-D scalar case* September 26- 30, 2022
- **Summer school on analysis and applied mathematics** Münster, Germany  
*The graph space of abstract Friedrichs operators* September 12-16, 2022  
*and classification of classical Friedrichs operators in 1-D scalar case*
- **Summer school on heat kernels and spectral geometry** Bregenz, Austria  
*Abstract Friedrichs Operators* August 30- Sept 3, 2022
- **Analysis, PDEs and applications,** Dubrovnik, Croatia  
*Celebrating 60th anniversary of Nenad Antonić* June 19-24, 2022  
*The graph space of abstract Friedrichs operators*
- **7th Croatian mathematical congress** Split, Croatia  
*Classical Friedrichs operators in one dimensional scalar case* June 15-18, 2022
- **Seminar for differential equations and numerical analysis** PMF Zagreb, Croatia  
*Fundamental solutions of linear partial differential operators with constant coefficients* June 06, 2022
- **Seminar for differential equations and numerical analysis** PMF Zagreb, Croatia  
*Classification of classical Friedrichs differential operators:* Feb 07, 2022  
*One dimensional scalar case*
- **Seminar for differential equations and numerical analysis** PMF Zagreb, Croatia  
*Abstract Friedrichs operators and the graph space* Jan 24, 2022
- **Seminar for differential geometry** TIFR CAM, India  
*Gauss Bonnet theorem* April, 2019
- **Seminar for linear algebra** TIFR Cam, India  
*Geometric interpretation of determinant* April, 2018

## Awards, Grants and Honours

- Financial support from **University of Osijek** and **University of Zagreb** to present my research during July2-5, 2024 at University of Osijek.
- Financial support from **University of Padova** and **University of Zagreb** to present my research during June 24-28, 2024 at University of Padova, Italy.
- Financial support from **University of Osijek** to present my research during December 11-13, 2023 at University of Osijek.

- Financial support from **University of Osijek** to present my research during December 11-13, 2023 at University of Osijek.
- Financial support from **Croatian Science Foundation** to attend and present my research work in the 7th Najman conference on spectral theory and numerical analysis during September 18-23, 2023 in Brijuni, Croatia.
- Financial support from **University of Wuppertal, COST and Croatia Science Foundation** to attend the workshop in positive operator semigroups during September 4-8, 2023 in Budapest.
- Financial support from **Ph.D. supervisor's MiTPDE grant and Croatian Science Foundation** to attend and present a poster in summer school Horizontes in non-linear PDEs during September 26-30, 2022 at ULM, Germany.
- Financial support from **University of Münster and Croatian Science Foundation** to attend and present a poster in summer school in analysis and applied mathematics during September 12-16, 2022 at Münster, Germany.
- Financial support from **COST European cooperation in science and technology** to attend and present a poster in summer school on heat kernels and spectral geometry during August 30-Sept 03, 2022 at Bregenz, Austria.
- Financial support from my **Ph.D. supervisor's MiTPDE grant and Croatian Science Foundation** during June 19-24, 2022 to attend and present my research work in the conference "Analysis, PDEs and applications" at Dubrovnik, Croatia.
- Financial support from **Croatian Science Foundation** during June 14-18, 2022 to attend and present my research work in "7th Mathematical Congress" organised by University of Split, Croatia.
- **Croatian Science Foundation (HRZZ)** PhD fellowship from Nov, 2019 to present.
- **Tata Institute of Fundamental Research (TIFR)** masters fellowship from July 15, 2017 to July 31, 2019.
- One of the top 21 students on interview of **TIFR-CAM** exams in March, 2017.
- One of the top 72 students on **TIFR** written exams in Dec 12, 2016.
- Achieved 1st rank in high school **Board Exams** in 2010 and got awarded by various organisations.
- Rewarded with **Medha Scholarship** for passing the state level high school competitive exam in 2009.
- Rewarded for breaking the record highest previous score in high school exams in 2008.
- Rewarded for a project on **Prime Numbers** in School.
- Rewarded with full exemption in school fees for securing the first position in school for five years before going to high school.

### Conferences, Workshops and Teaching:

- **8th Croatian mathematical congress**, organised by University of Osijek, Croatia, on July 2- 5, 2024, at Osijek, Croatia.

- **Mini-courses in mathematical analysis**, organised by University of Padova, Italy, on June 24-28, 2024, at Padova, Italy.
- **Horizons in non-linear PDEs**, organised by University of ULM, Germany, on September 26- 30, 2022, at ULM, Germany.
- **Summer School in Analysis and Applied Mathematics**, organised by University of Münster, Germany, on September 12-16.
- **Summer School on Heat Kernels and Spectral Geometry**, organised by University of Hagen, Germany, on August 30- Sept 03, 2022 at Bregenz, Austria.
- **Analysis, PDEs and Applications**, celebrating 60th anniversary of Nenad Antonić during June 19-24, 2022, Dubrovnik, organised by University of Zagreb, Croatia.
- **7th Croatian Mathematical Congress** during June 14-18, 2022, organised by Department of Mathematics, University of Split, Croatia.
- Internal seminar for **Non local Homogenisation** during April 2022, Department of Mathematics, University of Zagreb, Croatia.
- **Internet Seminar on Spectral Theory for Operators and Semigroups (ISEM 25)** 2021/22: Followed lectures and participated in problem solving, assigned to the group of University of Zagreb, Croatia.
- **Seminar for Microlocal Analysis** during Feb 2022, Department of Mathematics, University of Zagreb, Croatia.
- **Internet Seminar on Evolutionary Equations (ISEM 23)** 2019/20: Followed lectures and participated in problem solving, assigned to the group of University of Zagreb, Croatia.
- Teaching **Linear Algebra and Real Analysis** at **St. Columba's College** during July-October 2019, Hazaribag, India.
- Project work on **Maxwell's System of Equations** in April 2019, under the guidance of **Prof. Vishal Vashan** TIFR International Center for Theoretical Sciences (ICTS).
- Compact course on **Mathematical Aspects of Euler Equations** by **Prof. Edward Feireisl** during Jan 21-Feb 02, 2019, organised by TIFR Centre for Applicable Mathematics (CAM), Bangalore, India.
- Project work on **Geometric Measure Theory** during June 2019, at TIFR CAM.
- **Scalar Conservation Laws with Convexity** during Summer, 2018, by **Prof. Y.J.Kim** from Dept. of Mathematical Sciences, Kaist, organised by TIFR CAM.
- Project on **Measure Theory and Functional Analysis** during Summer 2018, under the supervision of **Prof. Sandeep Kunnath** at TIFR CAM, India.
- Teaching advance courses on Classgap online learning platform (**Discrete Mathematics, Linear Algebra, Linear and Non-linear Optimisation, Numerical Analysis**).
- Teaching **Discrete Mathematics** during Aug-Nov, 2016, at an institute called Noble Forum in Hazaribag, India.
- Teaching **Geometry and Algebra** during Aug-March, 2016, at Student Friends' Coaching Center, Hazaribag, India.

- Teaching **Science and Mathematics** from May 2010 to April 2011 at N.S.C. Bose School, Hazaribag, India.

### Special Skills and Languages:

- *Python*:
- *MATLAB*:
- *English*: native.
- *Hindi*: fluent.
- *German*: beginner.

### Advanced Courses and Lectures attended:

- Semigroup theory and evolution partial differential equations
- Spectral Theory.
- Spectral Geometry.
- Pseudo Differential operators.
- Mathematical Modelling.
- Linear Hyperbolic Partial Differential Equations.
- Parabolic Partial Differential Equations.
- Lectures on Pseudo-differential operators.

### References

- Assoc. Prof. Marko Erceg, Faculty Member at Department of Mathematics, Faculty of Science, University of Zagreb, Croatia  
E-mail:maerceg@math.hr
- Prof. Nenad Antić, Faculty Member at Department of Mathematics, Faculty of Science, University of Zagreb, Croatia  
E-mail: nenad@math.hr