

# Advanced Functional Analysis and its Applications 2023

Sponsored By: NISER Bhubaneswar, IIT Hyderabad

## About the Speakers

**V. S. Sunder** is a retired Professor of mathematics from IMSc. He is one of the leading mathematicians in India. He has made several notable contributions in the broad areas of operator theory and operator algebras. Prof. V.S. Sunder has received several awards and recognitions, including the prestigious Shanti Swarup Bhatnager Prize for Mathematical sciences in 1996. He has authored several textbooks and is well-known for his clear and lucid writing style and lecturing style.



premier journals. He has co-authored a book with Prof. Gadadhar Misra titled 'Notes on the Brown, Douglas and Fillmore theorem'



**Kunal Krishna Mukherjee** is a Professor in the Department of Mathematics, at IIT Madras. He received his PhD from Texas A&M University. His research interest is in operator algebras.

**A.K. Vijayrajan** is an Associate Professor of Mathematics at KSCSTE-Kerala School of Mathematics. He obtained his Ph.D from ISI Bangalore in 1995. Dr. A. K. Vijayrajan works on the broad area of functional analysis and in particular operator algebras. His current research interest includes Quantum approximation and extremal theory in the context of  $C^*$ -algebras and von-Neumann algebras.



**A. Adimurthi** is a Professor in the Dept. of Mathematics, TIFR CAM. His research interest includes non linear PDE, Hamilton Jacobi equations, conservation laws and Hardy Sobolev spaces. He has been awarded the J.C. Bose fellowship. Professor A. Adimurthi is a Fellow of the Indian Academy of Sciences, Bangalore and the National Academy of Sciences (India), Allahabad.

**Antonio M. Peralta** is a Full Professor at the Department of Mathematical Analysis at the University of Granada. His research interest includes  $C^*$ -algebras, von-Neumann algebras,  $JB^*$ -triples and operator theory, geometric Properties of isomorphic and isometric type in Banach space theory, extension of isometries, Tingley's problem, Mazur-Ulam property.

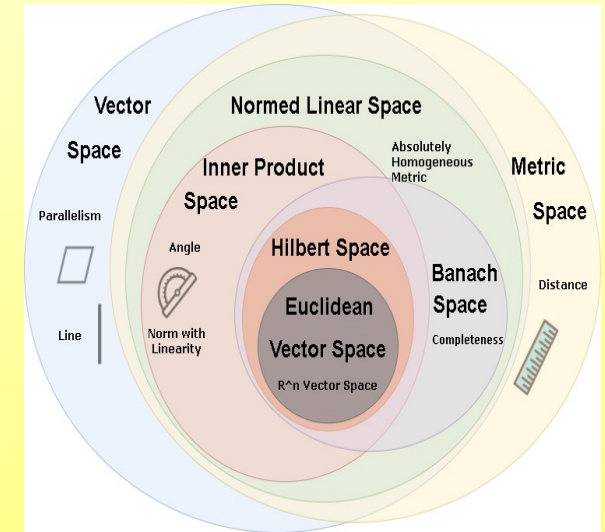


**Pradipta Bandyopadhyay** is a Professor at the Theoretical Statistics and Mathematics Division, ISI Kolkata. He got his Ph.D from ISI Kolkata in 1991. He has held several visiting positions in various universities abroad. His research interests are in Geometric functional analysis, particularly in the geometry of Banach spaces.

**Kallol Paul** is a Professor of Mathematics at Jadavpur University. His area of research is Operator Theory in Functional Analysis. Currently, he is actively involved in research in areas involving numerical radius inequalities, Birkhoff-James orthogonality, and its applications. He joined Jadavpur University in 2005.



**Sameer Chavan** is a Professor in the Dept. of Mathematics and Statistics, IIT Kanpur. Prof. Sameer Chavan received his Ph.D from University of Pune in 2007. His research interest includes function-theoretic and graph-theoretic operator theory. He has written several papers all in



## About the Department of Mathematics, IIT Hyderabad and NISER Bhubaneswar

The Department of Mathematics, IIT Hyderabad, currently has 22 faculty members, with interests ranging among pure, applied and computational mathematics. Various research groups with the same or complementary interests exist at a very local level. Faculty members maintain active collaborations with both eminent academics and groups in their particular areas of research on a national and international level. Algebraic geometry, commutative algebra, computational intelligence, fluid dynamics, functional analysis, number theory, and theoretical non-linear PDEs are among the department's current research areas. The department provides curriculums on B.Tech in Mathematics and Computing, Masters in Mathematics and Mathematics and Computing and a Ph.D. in Mathematics.

NISER along with its four schools, Biology, Chemistry, Mathematics and Physics started working in the year 2007. Presently, the School of Mathematical Sciences is offering three courses, Integrated M.Sc., M.Sc-Ph.D and Ph.D. programs. There are 23 regular faculty members, 1 inspire faculty member, 20 Ph.D.students, 15 post doctoral fellows. The areas of expertise the existing members are Functional Analysis, Operator Algebras, Non commutative geometry, Harmonic Analysis, PDE, Probability Theory, Algebra, Number Theory, Geometry and Topology, Graph Theory, Finite Geometry, Cryptography.

## Time & Venue

Department of Mathematics  
December 11-15, 2023  
NISER, Bhubaneswar



For details please contact:

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## Overview & Objectives

One of the fundamental subfields of analysis is functional analysis. This subject is offered at both the Master's and research levels by a number of universities and institutions. Depending on the needs of the teacher, this subject can be taught from a variety of perspectives. However, its core is the study of normed spaces, along with the study of function spaces over various domains, and the behaviour of the operators on normed spaces from both the linear and nonlinear point of view. Functional analysis, in its broad sense, includes the study of various aspects of topologies on vector spaces, stochastic theory, non-commutative harmonic analysis and many more. This topic is also used by students of mathematical economics, financial mathematics, actuarial science, electrical mechanical engineering. Our main goal is to provide some cutting-edge subjects in this area that will be beneficial to both lecturers and research scholars. An extensive knowledge of the relevant subject and its related domains is essential for a lecturer. We think that by attending this workshop, people will get a deeper understanding and exposure to the subject.

## Number of Participants

The maximum number of participants for the course shall be limited to 40.

## Benefit

On successful completion of the course participation certificate will be awarded.

## Course contents

The course is aimed for the Lecturers, students, analysts and researchers who have already undergone a first course in Functional Analysis, Complex Analysis and Analysis of single and Multivariable functions. We propose the following topics which are supposed to be covered in this workshop.

1. A set of three lectures will be given by Prof. A. Adimurthi on Lax-Milgram Lemma and their applications. Here some properties of the  $L^2$  Sobolev spaces will be proved. Then the concept of weak solutions of the Second Order Elliptic PDE will be established. The Lax-Milgram Lemma and the existence of weak solutions will then be proved. The regularity results upto boundary will then be proved.

2. A series of three lectures will be given by Prof. Pradipta Bandopadhyay on Geometric Characterisations of the Radon-Nikodym property In Banach spaces. A Banach space  $X$  is said to have the Radon-Nikodym Property (RNP)

if the classical Radon-Nikodym Theorem holds for vector measures taking values in  $X$ . For example, it is known that reflexive spaces and separable dual spaces, like  $l_1$ , have the RNP. In this series of lectures, we will show that the RNP is equivalent to some geometric properties of Banach spaces. For example, it is equivalent to the statement that any closed bounded convex set is a closed convex hull of its denting points. A denting point is a stronger form of an extreme point. The main tool of the transition from a measure theoretic property to a geometric property is martingale convergence theorem.

3. A series of three lectures will be given by Prof. Kallol Paul on Extreme Contractions on Banach Spaces. A classical result of Kadison states that extreme contractions on Hilbert spaces are isometries or co-isometries. However, the study of the same on Banach spaces is an intriguing area of research, and the characterizations of the extreme contractions in the setting of Banach spaces still remain elusive. In this series of lectures, we plan to discuss the same, starting with operators defined between two-dimensional Banach spaces.

4. A set of three lectures will be given by Dr. Sameer Chavan on the Hausdorff moment problem. The moment problem is to ask for which sequences  $\{c_n\}_{n \geq 0}$  of positive real numbers,  $c_n$ 's are the moments of a measure, that is,  $c_n = \int t^n d\mu(t), n \geq 0$ , and if they are, is the measure unique. If the measure is unique, the problem is called determinate and if not, indeterminate. Depending on whether one restricts  $\mu$  to have support on a particular set  $\Omega$ , we have Hamburger moment problem ( $\Omega = \mathbb{R}$ ), Stieltjes moment problem ( $\Omega = [0, \infty)$ ) and Hausdorff moment problem ( $\Omega = [0, 1]$ ). In these lectures, the solution of the Hausdorff moment problem will be discussed.

5. A set of three lectures will be given by Dr. A. K. Vijayrajan on On operator systems and spaces in  $C^*$ -algebras. The non-commutative counterpart of the classical extremal theory concerning Choquet boundary of subspaces of uniform algebras, which proved to be a very important tool in classical analysis with applications in classical approximation theory, initiated by Arveson in the context of operator systems in  $C^*$  algebras led

to the notion of boundary representations for operator systems in  $C^*$ -algebras and developed into the theory non-commutative Choquet boundary and Silov boundary with far-reaching applications in non-commutative functional analysis. We will introduce these notions, develop the theory and consider certain applications.

## Link to the Website:

<https://sites.google.com/afaa-2023/home>

## Important dates

Last date  
For receiving  
Application  
15 Nov

Intimation to  
Participants  
17 Nov

Course  
Dates  
11-15  
December

## Registration fee details

There is no fee for the research scholars and postdoctoral fellows. For the employees, we charge only for local hospitality. An amount of 1000 INR can be transferred to the bank account as given the link below.

## Accommodation

A limited accommodation is available inside NISER campus. Accommodation may be provided first cum first service. Employees are requested to arrange their accommodation in the nearby hotel/ lodges.

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