Advanced Functional Analysis and its Applications

Sponsored By: TEQIP (Phase-III)

About the Speakers

Anil Karn is an Associate professor from NISER Bhubaneswar. He joined NISER on August, 2011 as a Reader-F. His area of interest is ordered Functional Analysis, Operator spaces.

Gadhadar Misra completed his PhD from the State University of New York at Stony Brook. He was a Visiting Assistant Professor at University of Georgia and the University of California. Started his career in Indian Statistical Institute and moved to the IISc on 2008. He was selected for the J C Bose Fellowship in the year of 2008, awarded the prestigious S. S. Bhatnagar Prize (CSIR) in 2001 and Biju Patnaik Award for his Scientific Excellence from the Odisha Bishyan Academy in 2013. His research is mostly related to operator theory which involves finding curvature inequalities for operators in the Cowen-Douglas class, describing homogeneous vector bundles and study of Hilbert modules.

M. N. N. Namboodiri was a professor of CUSAT, retired on 2014. He taught at IIT Palkad for a semester and joined CUSAT as an Emeritus Professor. Currently he is an Emeritus Scientist at CUSAT. His area of specialization is Functional Analysis and work on problems related to spectral analysis of operators, Chebyshev subspaces of operator algebras, Korovkin and Feller-type limit theorems in operator algebras.

Amin Sofi is an Adjunct Faculty at the Central University of Kashmir, Srinagar. Earlier he completed his term as Emeritus Professor at Kashmir University, Srinagar. He was awarded Ramanujan Prize in 2009. His research interests is Functional Analysis, in particular, Finite dimensionality phenomena, Embeddings theorems, Extendability of maps in Banach spaces.

T. S. S. R. K. Rao is a Visiting Professor from Ashoka University. He is a former Head of ISI Bangalore and Professor in Charge of ISI. Prof. Rao is one of the eminent Functional Analyst in India. He worked in various domain in it like Approximation Theory, Analysis on Banach spaces and their geometry, Choquet Theory, Optimization techniques etc.

Tirthankar Bhattacharyya is a professor in the Dept. of Mathematics of IISc. His area of research includes Hilbert space and Operator theory. His research has been widely appreciated all over the world and he has many collaborators in India and abroad. He is passionate in his teaching and has consistently been rated as an excellent teacher by the students of IISc as well as students in many summer courses and short term courses which he has participated in elsewhere.

Tanmoy Paul is an Assistant Professor from IIT Hyderabad. He completed his PhD from ISI Kolkata, his PhD work is related to Functional Analysis, Analysis on Banach spaces. His current area of interest is Functional Analysis, Banach space theory, Convex analysis and Geometric measure theory.

About the Department of Mathematics, IIT Hyderabad

The Department, founded along with the Institute in 2008, aspires to evolve into an internationally acclaimed centre for theoretical, interdisciplinary and applicable mathematical research, supporting and complementing the expertise extant in and around Hyderabad.

As one of the basic science departments, the department remains as the fulcrum of teaching that offers many foundational math courses for the entire community of students at IIT Hyderabad. The Master of Science programme of the department allows specialisation in two streams, viz. Theoretical Mathematics and Applied Math and Computing. The vibrant doctoral programme of the department attracts students of varied interests and has been successful in creating researchers who are well-prepared to enter both the academia and the industry.

The Department has young and dedicated faculty working both in pure and applied branches of Mathematics who actively collaborate with their counterparts from within and outside the department. Faculty members have achieved many distinctions - for instance, they have been invited to be part of research committees of the Government of India, are established resource personnel in programmes promoting both basic and advanced Mathematics and are members of the editorial board of reputed journals.https://math.iith.ac.in/about.html.

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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. Ordered vector spaces and vector lattices. Various norms related to these spaces, Extension and decomposition of linear maps. Proof of Kakutani theorem for M-spaces. (Will be covered by Dr. Anil Karn)


3. Two lectures on basic notions of Convexity and Smoothness in Normed linear spaces will be given. Various generalizations of Convexity and Smoothness. (Will be covered by Dr. Tanmoy Paul)

4. Three lectures will be given on the development of basic theory of vector measures leading to the celebrated Banach, Dunford and Schwartz representation theorem of weakly compact operators whose domain is the space of continuous functions on a compact space. This classical result is an extension of the well known Riesz representation theorem. The aim is also to discuss the recent result of Rao and Roy that extends Bartle-Dunford and Schwartz’s theorem to domains whose duals are isometric to L^p space. (Will be covered by Dr. TSSRK Rao)

5. It is quite well known that in his classic work P. Korovkin very skillfully used positivity of linear maps to unify many classical approximation processes of scalar functions. Later on W. Arveson extended a part of it to operator algebras, where complete positivity has been used to deal with the non commutativity. During the last two decades, probabilistic methods in approximation theory have been developed and Feller’s limit theorem is a clear indication of that. However it is known that the classical Korovkin’s theorem(first theorem) and Feller’s theorem are equivalent for compact intervals. Three lectures aiming at introducing the above classical results and applications in approximation theory. (Will be covered by Dr. Tirthankar Bhattacharya).

6. A set of three lectures will be given on distinguished varieties of the bidisc in $\mathbb{C}^2$. These are algebraic objects that play a very important role in Hilbert space operator theory. A complete characterization and relations to Ando’s classical inequality will be explained. (Will be covered by Dr. Tirthankar Bhattacharya).

7. Let G be a graph with n vertices denoted by $\{1,...,n\}$ and $E \subseteq \{1,...,n\}^2$ be the set of its edges.

Following Noga Alon, Assaf Naor and many others, define the Grothendieck constant of the graph G, denoted by $K(G)$, to be the smallest constant $K$ such that

$$\sup_{\|x\|_1 \leq 1, \|y\|_1 \leq 1, \|z\|_1 \leq 1} \sum_{(i,j) \in E} x(i) y(j) z(i) \leq K \sup_{\|x\|_1 \leq 1, \|y\|_1 \leq 1} \sum_{(i,j) \in E} x(i) y(j) .$$

holds true for any real matrix $A = (a_{ij})$.

The original Grothendieck inequality is the particular case that corresponds to the bipartite graphs (i.e. of chromatic number 2) and, as a consequence,

$$K = \sup K(G); G \text{ is a biparticular graph on n vertices}.$$}

We will discuss several connection of the Grothendieck inequality with several problems including the MAX CUT problem:

A cut in a undirected graph $G = (V, E)$ is defined as partition of the vertices of G into two sets; and the weight of a cut is the number of edges that has an end point in each set, that is, the edges that connect vertices of one set to the vertices of the other. The max-cut is the problem of finding a cut in G with maximum weight. (Will be covered by Dr. Gadadhar Misra)

Functional Analysis is one of the core areas in Analysis. Several Universities and Institutes offer this subject in their Master’s level as well as in their research level. This subject can be taught from many angles depending on the requirement of this subject. Functional Analysis, in its wide sense, includes the study of various aspects of topologies on Vector spaces, stochastic theory, non-commutative harmonic analysis, but its core is the study of normed spaces, together with the study of Function spaces over the various domain, behavior of the operators on normed spaces both from the linear and nonlinear point of view. Even people who are studying Mathematical Economics, Financial Mathematics, Actuarial Science, Electrical, Mechanical Engineering are also using this subject and its various tools in their respective fields.

Our prime objective is to offer some advanced topics in this field which would be helpful for a Lecturer and also a research scholar. It is always important and helpful for a Lecturer having a wide range of knowledge in the respective subject and its allied fields. We believe people will get a deeper view and exposure to the subject on attending this workshop.

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 Material & References

An electronic copy of the lectures and the course materials will be served to the registered participants. The following list of references are suggested for the participants