Inter IISER-NISER Mathematics Meet

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Titles and Abstracts of Talks

School of Mathematical Sciences

National Institute of Science Education and Research Bhubaneswar

(An Autonomous Institute under Department of Atomic Energy, Government of India)

Organizers: Anupam Pal Choudhury, Binod Kumar Sahoo, Brundaban Sahu, Chitrabhanu Chaudhuri, Dinesh Kumar Keshari, Sudhir Kumar Pujahari, Tushar Kanta Naik

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Plenary Talks

1. Amritanshu Prasad, IMSc Chennai
2. B.V. Rajarama Bhat, ISI Bangalore
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5. Sanjay Parui, NISER Bhubaneswar
6. Somnath Basu, IISER Kolkata

1. **Title:** Counting Subspaces in Relation to a Linear Operator
   Speaker: Amritanshu Parsad
   Abstract: Let $T \in M_n(\mathbf{F}_q)$. The number of T-invariant subspaces of $\mathbf{F}_q^n$ admits a simple elegant expression based on the Jordan canonical form of T. More generally, the number of T-invariant flags with given subspace dimensions is related to Hall-Littlewood symmetric functions. A T-anti-invariant subspace is a subspace W such that $\dim(W + TW) = 2\dim(W)$. A formula expressing the number of T-anti-invariant subspaces in terms of the number of T-invariant subspaces was discovered recently in collaboration with Samrith Ram. This formula has surprising connections with Heine's theory of q-hypergeometric functions and the sequence of q-Hermite orthogonal polynomials introduced by Rogers, and whose combinatorial theory was developed by Ismail, Stanton, and Viennot.

2. **Title:** Peripheral Poisson boundary
   Speaker: B. V. Rajarama Bhat
   Abstract: It is shown that the operator space generated by peripheral eigenvectors of a unital completely positive map on a von Neumann algebra has a C*-algebra structure. This extends the notion of non-commutative Poisson boundary by including the point spectrum of the map contained in the unit circle. The main ingredient is dilation theory. This theory provides a simple formula for the new product. The notion has implications to our understanding of quantum dynamics. For instance, it is shown that the peripheral Poisson boundary remains invariant in discrete quantum dynamics. This talk is based on a joint work with Samir Kar and Bharat Talwar.

3. **Title:** Two perspectives in number theory: explicit and probabilistic
   Speaker: Kaneenika Sinha
   Abstract: "Explicit" number theory is the name given to the study of what are called zero-free regions of the Riemann zeta function and other L-functions. An explicit determination of such regions often reveals deep arithmetic properties of the underlying object attached to the concerned L-function. More generally, it could refer to the use of "explicit", often technical techniques to understand an arithmetic object. On the other hand, "probabilistic" number theory attempts to investigate arithmetic properties of an object by treating the object as one in a family of many, and exploring these families of varying sizes through the viewpoint of probability. In this talk, we will explore both perspectives and compare the wealth of information each perspective presents to us.

4. **Title:** Algebra and topology of solutions to the Yang-Baxter equation.
   Speaker: Mahender Singh
   Abstract: The quantum Yang-Baxter equation is a fundamental equation that first arose in mathematical physics in the works of C. N. Yang and R. Baxter in the 1960s. From a mathematical perspective, the equation is simply the braid relation. The program to understand and classify set-theoretical solutions to the Yang-Baxter equation was envisaged by Vladimir Drinfeld in the 1990s. In this talk, we will discuss some of the solutions to

the Yang-Baxter equation that have been the center stage of research on the subject. This includes structures such as skew braces, racks, and quandles. These algebraic structures provide bijective non-degenerate solutions to the Yang-Baxter equation and are intimately related to invariants of links in 3-space, combinatorial group theory, generalized braid groups, and mapping class groups of surfaces, to name a few. If time permits, we will also mention some of our recent results regarding cohomology and finiteness properties of these solutions.

5. **Title:** Classical Operators of Harmonic Analysis in Dunkl analysis
   Speaker: Sanjay Parui
   Abstract: We will discuss some classical operators of Harmonic Analysis in Dunkl set up and explore the difference and difficulties obtaining the classical results of Harmonic Analysis in Dunkl set up.

6. **Title:** From groups to geodesics via Hochschild
   Speaker: Somnath Basu
   Abstract: We shall recall group cohomology of a group via Eilenberg-Maclane spaces, leading to Hochschild (co)homology. This cohomology theory for algebras has surprising connections to homology of (free) loop space of oriented manifolds and its associated algebraic structures.

Algebra

1. Anupam Kumar Singh, IISER Pune
2. Kumar Balasubramanian, IISER Bhopal
3. Md. Ali Zinna, IISER Kolkata
4. Rekha Biswal, NISER Bhubaneswar
5. Tanusree Khandai, IISER Mohali
6. Harish Kishnani, IISER Mohali
7. Pravin Kumar, IISER Mohali
8. Shushma Rani, IISER Mohali
9. Soumitra Das, IISER Berhampur
10. Sourayan Banerjee, IISER Bhopal
11. Sourjya Banerjee, IISER Kolkata
12. Tejbir, IISER Mohali

1. **Title:** Finiteness of z-classes in reductive groups.
   Speaker: Anupam Kumar Singh
   Abstract: Let G be a group. For elements x, y in G, we say that x and y are z-equivalent if the centralisers of x and y are conjugate in G. The equivalence classes under z-equivalence are called z-classes. Each z-class is a union of the conjugacy classes in G which are G-isomorphic to a given conjugacy class. In this talk, we explore this for reductive groups over certain fields. Let k be a perfect field such that for every n there are only finitely many field extensions, up to isomorphism, of k of degree n. If G is a reductive algebraic group defined over k, whose characteristic is "very good" for G, then it turns out that $G(k)$ has only finitely many z-classes.

2. **Title:** Twisted Jacquet Module
   Speaker: Kumar Balasubramanian
   Abstract: Let F be a finite field and $G = \mathrm{GL}(2n, F)$. In this talk, we will present some results on the structure of the twisted Jacquet module for an irreducible cuspidal representation of G.

3. **Title:** Efficient generation of ideals in a discrete Hodge algebra
Speaker: Md. Ali Zinna
Abstract: For an ideal I in a Noetherian ring R, let $\mu(I)$ be the minimal number of generators of I. It is well known that there is a sequence of inequalities $\mu(I/I^2) \leq \mu(I) \leq \mu(I/I^2) + 1$ that are strict in general. To see when the lower inequality becomes an equality has been the theme of many articles in the literature; and this equality depends heavily on the properties of the ring as well as the ideal.In this talk we will consider ideals in a discrete Hodge algebra and provide some situations when this lower inequality becomes an equality.

4. **Title:** Ideals in enveloping algebras of affine Kac-Moody algebras
Speaker: Rekha Biswal
Abstract: In this talk, I will discuss about the structure of ideals in enveloping algebras of affine Kac-Moody algebras and explain a proof of the result which states that if $U(L)$ is the enveloping algebra of the affine Lie algebra L and c is the central element of L, then any proper quotient of $U(L)/(c)$ by two sided ideals has finite GK dimension and also talk about the applications of the result including the fact that $U(L)/(c - \lambda)$ for non zero λ are simple. This talk is based on joint work with Susan J. Sierra.

5. **Title:** Demazure fitrations of Tensor product representations of current Lie algebras.
Speaker: Tanusree Khandai
Abstract: The current algebra $\mathfrak{g}[t]$ of a simple Lie algebra $\mathfrak{g}$ is the Lie algebra of polynomial maps $\mathfrak{C} \to \mathfrak{g}$. In this talk we will discuss our results on the structure of the tensor product of level 1 Demazure modules of $\mathfrak{g}[t]$ of type A_1 with special Demazure modules. We will show that the Chari-Venkatesh modules prove to be effective tools to understand the structure of these modules. We conclude the talk by giving the graded characters of these tensor product modules and relating them to certain partition identities. This is a joint work with Divya Setia.

6. **Title:** Images and probability distributions of Word maps
Speaker: Harish Kishnani
Abstract: Let F_d denote the free group on d letters and $0 \neq w \in F_d$ be a word. For a group G, let G^d denote the group of d-tuples in G. A *word map* $\tilde{w} : G^d \to G$ is the evaluation map of w on these d-tuples. The image of $\tilde{w}$ is denoted by $w(G)$.
In this talk, I will first discuss a collaborative work done with Kaur and Kulshrestha. This work is inspired from an article by Alexander Lubotzky, in which he has shown that automorphism invariant subsets of finite simple groups which contain identity are always word images. We observed that this result is not true in general for non-abelian finite simple groups. In fact, we showed that except elementary abelian groups, all finite nilpotent groups have subsets that are automorphism invariant, contain identity of the group, but are not word images. We termed these subsets as *word image impostors*, and classified them for the class of extraspecial p-groups. In the course of it, we construct a 2-exhaustive set of word maps on nilpotent groups of class 2 and demonstrate its minimality in some cases.
The second half of the talk will be based on an extension of this idea to the idea of *fibre size equivalence*. Kulshretha and I proved several results related to fibre size equivalence for nilpotent groups of class 2 and as an immediate consequence showed that all class 2 groups are rational. The main motivation behind it was the conjectures by Amit and Ashurst. The idea of fibre size equivalence also enabled us to prove several results in this direction including the improvement in the already known bound and proving the conjecture for certain classes of words and groups.

7. **Title:** Exotic Groups in low dimensional topology
Speaker: Pravin Kumar
Abstract: The symmetric group, S_n, has three natural extensions: the braid group B_n, the twin group T_n, and the triplet group L_n. The latter two families of Coxeter groups can be thought of as planar forms of Artin braid groups and have a deep connection with low-dimensional topology. The virtual braid group VB_n (virtual twin groups VT_n and virtual triplet group VL_n) is an extension of the Artin braid group (twin group and triplet group) by the symmetric group. A discrete subgroup Γ of the group of isometries $\mathrm{Isom}(\mathbb{R}^n)$ of Euclidean n-space, with a compact fundamental domain, called an n-dimensional crystallographic group. In this talk, we determine explicit presentation of the commutator subgroup of virtual twin groups and virtual triplet groups and determine some natural crystallographic quotients of twin groups and (virtual) triplet groups. The content of this talk is part of recent work with Dr. Mahender Singh, Dr. Tushar Kanta Naik and Dr. Neha Nanda.

8. **Title:** Free root spaces of Borcherds-Kac-Moody Lie superalgebras.
Speaker: Shushma Rani
Abstract: Let $\mathfrak{g}$ be a Borcherds-Kac-Moody Lie superalgebra (BKM superalgebra in short) with the associated graph G. Any such $\mathfrak{g}$ is constructed from a free Lie superalgebra by introducing three different sets of relations on the generators:
(1) Chevalley relations, (2) Serre relations, and
(3) Commutation relations coming from the graph G.
By Chevalley relations we get a triangular decomposition $\mathfrak{g} = \mathfrak{n}_+ \oplus \mathfrak{h} \oplus \mathfrak{n}_-$ and each roots space $\mathfrak{g}_\alpha$ is either contained in $\mathfrak{n}_+$ or $\mathfrak{n}_-$. In particular, each $\mathfrak{g}_\alpha$ involves only the relations (2) and (3). In this talk, we will discuss the root spaces of $\mathfrak{g}$ which are independent of the Serre relations. We call these roots free roots of $\mathfrak{g}$. Since these root spaces involve only commutation relations coming from the graph G we can study them combinatorially using heaps of pieces.

9. **Title:** Injectivity versus divisibility over Leavitt path algebras
Speaker: Soumitra Das
Abstract: It is well know that if R is a principal (right or left) ideal ring, i.e, a ring in which all (right or left) ideals are principal then all (right or left) R-modules are divisible iff all (right or left) R-modules are injective. Recall that a right R-module M is said to be *divisible* if for any a in R, any R-homomorphism $f : aR \to M$ extends to an R-homomorphism from R to M. In this talk, we shall see that all divisible modules are not necessarily injective over a Leavitt path algebra, by precisely constructing a non-injective divisible module.

10. **Title:** Lambda Module Structure On Higher K- Groups
Speaker: Sourayan Banerjee
Abstract: The notion of λ-rings plays an important role in K-theory. In fact, the Grothendieck group K_0 has a λ-ring structure with usual exterior power operation on vector bundles. Recently, L. Hesselholt introduced the concept of λ-module, i.e., module over a λ-ring. For a λ-ring (A, λ_A), $Mod(A, \lambda_A)$ denotes the category of (A, λ_A)-modules. It is an abelian category. It is not easy to find an object of $Mod(A, \lambda_A)$. Using Grayson's binary complex technique, we show that the higher K-groups $K_{n>0}(X)$ are objects of $Mod(K_0(X), \lambda_{K_0(X)})$, where X is any quasicompact scheme.

11. **Title:** Unimodular rows over positively graded rings
Speaker: Sourjya Banerjee
Abstract: Let R be a commutative Noetherian ring with $1(\neq 0)$ of (Krull) dimension $d \geq 1$. A row vector $v = (v_1, ..., v_n) \in R^n$ is considered a unimodular row of length n if the ideal $\langle v_1, ..., v_n \rangle R = R$. It is easy to observe that any row vector of an invertible matrix in R is a unimodular row. However, the converse of this statement is generally not true. When a unimodular row of length n corresponds to a row of an $n \times n$ invertible matrix, we say that the unimodular row is comparable to an invertible matrix. It can be shown that whenever $n \geq d + 2$, any unimodular row of length n can be completed to an invertible matrix. In fact, within this range, unimodular rows can be extended to the first row of an elementary matrix. This bound is generally optimal. In this talk, we discuss that aforementioned bound in the case where the ring R has a non-negative (non-trivial) grading.

12. **Title:** Product of two involutions in special linear groups
Speaker: Tejbir
Abstract: Reversible elements in a group are those elements that are conjugate to their own inverses. They are closely related to strongly reversible elements, which can be expressed as a product of two involutions. It has been a problem of broad interest to classify reversible and strongly reversible elements in a group. In this talk, we will provide a complete count of reversible and strongly reversible elements in the special linear groups $\mathrm{SL}(n, \mathbb{C})$ and $\mathrm{SL}(n, \mathbb{H})$. This is a joint work with Prof. Krishnendu Gongopadhyay and Dr. Chandan Maity.

Analysis

1. Diganta Borah, IISER Pune
2. Haripada Sau, IISER Pune
3. Md. Ramiz Reza, IISER Thiruvananthapuram
4. Ritabrata Sengupta, IISER Berhampur
5. Soumalya Joardar, IISER Kolkata
6. Sushil Gorai, IISER Kolkata
7. Chaitanya J. Kulkarni, IISER Bhopal
8. Debabrata De, NISER
9. Md Amir Hossain, IISER Bhopal
10. Sanjoy Chatterjee, IISER Kolkata

1. **Title:** Remarks on the squeezing function
Speaker: Diganta Borah
Abstract: The squeezing function is a biholomorphic invariant of bounded domains introduced by Deng, Guan, and Zhang and is a measure of how well a domain can be squeezed between two Euclidean balls. The idea of squeezing goes back to the work of Liu, Sun, and Yau where they studied the equivalence of the Carathéodory, Kobayashi, and Bergman metrics on Teichmüller spaces of compact Riemann surfaces using the Bers' embedding theorem. In this talk, we will discuss a class of problems associated with its computation and connections with the intrinsic geometry of domains. We will also present a new application of this function. This is joint work with Gautam Bharali and Sushil Gorai.

2. **Title:** A Constrained Andô Dilation Problem
Speaker: Haripada Sau
Abstract: The Andô's Inequality and its remarkable improvements first for certain matrices by Agler and McCarthy (Acta Math., 2005) and then for certain operators by Das and Sarkar (J. Funct. Anal., 2017) motivate us to ask a question which can be seen as a Constrained Andô Dilation problem. The statement involves a class of two-variable polynomials with a

geometric condition on its zero sets, called the toral polynomials. If a pair of commuting operators is annihilated by a toral polynomial, then the pair is called a toral pair. Does every toral pair of commuting contractions lift to a toral pair of commuting isometries? In this talk, we shall see how exactly the results cited above inspire the question and why one may want to find an answer to the problem.

3. **Title:** Generalized Cesàro summability of Taylor series in higher order weighted Dirichlet spaces
Speaker: Mohammed Ramiz Reza
Abstract: To each finite, positive, Borel measure μ on the unit circle and for a positive integer m, we study m-th order weighted Dirichlet-type integral $D_{\mu,m}(f)$ given by

$$D_{\mu,m}(f) := \frac{1}{m!(m-1)!}\int_{\mathbb{D}} \left|f^{(m)}(z)\right|^2 P_\mu(z)(1-|z|^2)^{m-1}dA(z),\ \ f \in \mathcal{O}(\mathbb{D}).$$

Here $P_\mu(z)$ is the Poisson integral of the measure μ. The associated m-th order weighted Dirichlet-type space $\mathcal{H}_{\mu,m}$, defined by $\mathcal{H}_{\mu,m} = \{f \in \mathcal{O}(\mathbb{D}) : D_{\mu,m}(f) < \infty\}$, plays a crucial role in the study of analytic m-isometries. We find that for every $\alpha > \frac{1}{2}$ and $f \in \mathcal{H}_{\mu,m}$,

$$D_{\mu,m}\big(\sigma_n^\alpha[f] - f\big) \to 0 \text{ as } n \to \infty,$$

where $\sigma_n^\alpha[f]$ denotes the generalized Cesàro means associated to the Taylor series of the function f. This is a joint work with Dr. Rajeev Gupta and Dr. Soumitra Ghara.

4. **Title:** A Szegoo type theorem and distribution of symplectic eigenvalues
Speaker: Ritabrata Sengupta
Abstract: We study the properties of stationary G-chains in terms of their generating functions. In particular, we prove an analogue of the Szego limit theorem for symplectic eigenvalues, derive an expression for the entropy rate of stationary quantum Gaussian processes, and study the distribution of symplectic eigenvalues of truncated block Toeplitz matrices. We also introduce a concept of symplectic numerical range, analogous to that of numerical range, and study some of its basic properties, mainly in the context of block Toeplitz operators.

5. **Title:** Equivariant C^*-correspondence
Speaker: Soumalya Joardar
Abstract: Let G be a compact quantum group. Then upon introducing the notion of a G-equivariant C^*-correspondence and a $G-C^*$-algebra, we shall show that a G-equivariant C^*-correspondence makes the associated Pimsner algebra a $G-C^*$-algebra. Moreover for a Kac type CQG G, under a natural condition, the corresponding G-action on the Pimsner algebra preserves the KMS state coming from a quasi-free dynamics if and only if it preserves the restriction of the KMS state on the coefficient C^*-algebra of the C^*-correspondence. We shall apply the results on the C^*-correspondence coming from a finite, directed graph without sources to understand the connection between the quantum symmetry of the graph C^*-algebras and their underlying graphs. This talk is based on a recently arxived joint work with Dr. Suvrajit Bhattacharjee.

6. **Title:** Polynomial convexity of compacts that lies in certain Levi-flat hypersurfaces
Speaker: Sushil Gorai
Abstract: In this talk we first discuss the notions of polynomial convexity and Levi flat hypersurfaces in the complex Euclidean spaces. We, then, present several examples of non-singular Levi-flat hypersurfaces in which the totally real discs are polynomially convex.

Next we discuss the Levi-flat hypersurfaces that have singularities and present certain results concerning polynomial convexity of the totally real discs lying in them. We will particularly focus on the boundaries of polynomial polyhedra and the boundary of the Hartogs triangle. This is a joint work with Golam Mostafa Mondal.

7. **Title:** Orthogonal and Ergodic Decomposition of a Unital Completely Positive Map
Speaker: Chaitanya J. Kulkarni
Abstract: For a given separable C*-algebra A and a state $\omega : A \to \mathbb{C}$ with the GNS-representation π_ω, Effros established a connection between the barycentric decomposition of ω and the disintegration of π_ω, using a special class of barycentric measures called *orthogonal* measures.
From the perspective of unital completely positive (UCP) maps, a state $\omega : A \to \mathbb{C}$ can be viewed as a UCP map with a one-dimensional, commutative range and π_ω be the corresponding minimal Stinespring dilation. In the first part of the talk, we take this approach for a UCP map $\phi : A \to B(H)$ with the minimal Stinespring dilation $V^*\rho V$, connecting the barycentric decomposition of ϕ and the disintegration of ρ which generalizes Effros' work in the non-commutative setting. We do this by introducing a special class of barycentric measures which we call *generalized orthogonal* measures. Further, we will see some applications and examples of generalized orthogonal measures.
In the next part, we introduce ergodic UCP maps by considering an action of a group G on a separable C*-algebra A. Then we characterize such maps using the minimal Stinespring dilation. Finally, we will present our ongoing work on orthogonal and ergodic decomposition of equivariant UCP maps which uses the concept of generalized orthogonal measures.

8. **Title:** On symmetric embedding of purely atomic von Neumann algebras
Speaker: Debabrata De
Abstract: In this talk, we discuss symmetric embedding of von Neumann algebras and characterize purely atomic von Neumann algebras. This talk is based on a recent joint work with P. Bikram and K. Mukherjee.

9. **Title:** KMS states on the C*-algebra of a Fell bundle over an étale groupoid
Speaker: Md Amir Hossain
Abstract: Let $\mathcal{A}$ be a (saturated) Fell bundle over a locally compact, Hausdorff, second countable, étale groupoid G, and $\mathrm{C}^*(G;\mathcal{A})$ denote its full C*-algebra. In this talk, we define $\mathrm{C}^*(G;\mathcal{A})$ without using Muhly–Williams disintegration theorem and show that the our definition of the algebra $\mathrm{C}^*(G;\mathcal{A})$ is same as Muhly–Williams' one. Then we prove an integration-disintegration theorem for KMS states over $\mathrm{C}^*(G;\mathcal{A})$ for certain real dynamical system by establishing a one-to-one correspondence between such states and certain measurable fields of states on the C*-algebras of the Fell bundles over the isotropy groups. This correspondence is established for states on $\mathrm{C}^*(G;\mathcal{A})$ also under a commutativity hypothesis. While proving this main result, we construct an induction C*-correspondence between $\mathrm{C}^*(G;A)$ and the C*-algebra of the isotropy Fell bundle. And finally, we shall apply our result to some concrete situations such as (twisted) crossed product of groupoids and G-spaces. This is a joint project with Rohit Dilip Holkar.

10. **Title:** Approximations on spirallike domains of $\mathbb{C}^n$
Speaker: Sanjoy Chatterjee
Abstract: We first show that any domain Ω in $\mathbb{C}^n (n \geq 2)$, which is spirallike with respect to a complete holomorphic globally asymptotic stable vector field F, is a Runge domain. Next, we prove an Andersén-Lempert type approximation theorem: any biholomorphism $\Phi \colon \Omega \to \Phi(\Omega)$, with $\Phi(\Omega)$ is Runge, can be approximated by automorphisms of $\mathbb{C}^n$ uniformly on compacts, in the following two cases.
    (i) The domain $\Omega \subset \mathbb{C}^n$ is a spirallike with respect to a linear vector field A, where $2\max\{\mathrm{Re}\lambda : \lambda \in \sigma(A)\} < \min\{\mathrm{Re}\lambda : \lambda \in \sigma(A)\}$.
    (ii) The domain Ω is spirallike with respect to complete globally exponentially stable vector field F, with a certain rate of the convergence of the flow of the vector field F in Ω.
We also present some consequences of the theorem in Loewner PDE.

Discrete Mathematics, Probability and Statistics

1. Anindya Goswami, IISER Pune
2. Anirban Banerjee, IISER Kolkata
3. Kartick Adhikari, IISER Bhopal
4. Kaushik Majumder, NISER
5. Krishna Kaipa, IISER Pune
6. Moumanti Podder, IISER Pune
7. Amit Roy, NISER
8. Binod Kumar Sahoo, NISER
9. Sanjay Mukherjee, NISER

1. **Title:** Mathematical, Statistical, and Computational Studies on Fair Pricing in Financial Market
Speaker: Anindya Goswami
Abstract: We often purchase products or services to protect ourselves from some uncertainties. Warranty is one of them. Finding out a fair price for a warranty is not an easy task. Since the financial market consists of risky assets, traders also purchase some warranty-type contacts. These are called OPTIONs. Several different types of options are traded by numerous traders every day in every stock exchange. Finding out a fair price of an option is one of the central questions in Mathematical Finance. Different researchers, in academia or industry, having various backgrounds including differential equations, control theory, probability theory, statistical inference, numerical analysis, economics, machine learning, etc. participate in serious research in option pricing. I will explain some of these research directions along with some of my own contributions.

2. **Title:** Symmetries in Hypergraphs and Equivalence Relation-compatible Matrices
Speaker: Anirban Banerjee
Abstract: Here, we explore the interrelation between structural symmetries in a hypergraph H and the matrices associated it. We use equivalence relations on the vertex set $V(H)$ of H to represent the symmetries of H. A matrix associated with H may or may not encode complete information about a symmetry in H. Thus, for a particular symmetry of H, it is natural to ask what is the family of matrices, which encodes the information about that symmetry. For an equivalence relation $\mathfrak{R}$ on $V(H)$, $\mathfrak{R}$-compatible matrices are a family of matrices that encodes the information about the symmetry of H represented by $\mathfrak{R}$.

We observe that the symmetry corresponding to $\mathfrak{R}$ leaves its traces in the spectra of $\mathfrak{R}$-compatible matrices. Moreover, $\mathfrak{R}$ leads us to invariant subspace of $\mathfrak{R}$-compatible matrices. We introduce the notion of a unit, a symmetric structure where the corresponding class of equivalence relation compatible matrices includes adjacency, Laplacian, and signless Laplacian matrices of a hypergraph. Besides the spectra of corresponding equivalence relation compatible matrices, units are also interrelated with hypergraph automorphisms, random walks on hypergraphs, and the chromatic number of hypergraphs.

3. **Title:** The cover time of a random walk on Linial-Meshulam Model
Speaker: Kartick Adhikari
Abstract: The cover time of a graph means the expected number step taken by a random walk on this graph to visit all the vertices of the graph. We consider a d-dimensional simplicial complex which contains the complete $(d-1)$-skeleton and each d-simplex with probability p. In this talk, we shall discuss the cover time of a random walk on this complex, where the walk starts from a $(d-1)$-simplex and each step walker moves uniformly to one of the neighbouring $(d-1)$-simplex from its present position.This talk will be based on a joint work with Robert Adler, Omer Bobrowski and Ron Rosenthal.

4. **Title:** The Szemerédi regularity Lemma
Speaker: Kaushik Majumder
Abstract: We emphasise some part of the proof of Szemerédi regularity Lemma.

5. **Title:** On the classification of lines of $PG(3,q)$ with respect to the twisted cubic.
Speaker: Krishna Kaipa
Abstract: We consider the open problem of classifying the lines of $PG(3,q)$ into orbits under the group $G = PGL(2,q)$ of linear symmetries of the twisted cubic curve C. The other problem we study is to classify binary quartic forms over $GF(q)$ into G-orbits. Such a binary quartic form $f(X,Y)$ has a fundamental G-invariant $I(f)$ which is a quadratic form in f. For characteristic different from 2 and 3, the curve C induces a symplectic polarity on $PG(3,q)$ and we show that there is a correspondence (which respects the G-action) between the set of pairs of lines which are polar duals of each other on one hand, and the set of binary quartic forms over $GF(q)$ whose I-invariant is a square in $GF(q)$, on the other hand. We will present the solution to both of these problems. This is a joint work with Dr. Puspendu Pradhan and Dr. Nupur Patanker.

6. **Title:** Bond percolation games and their generalizations on rooted Galton-Watson trees
Speaker: Moumanti Podder
Abstract: (Joint work with Sayar Karmakar, Souvik Roy, Soumyarup Sadhukhan) Given a rooted Galton-Watson tree T_χ with offspring distribution χ, we assign to each edge of T_χ, independently, a label that reads *trap* with probabililty p, *target* with probability q, and *safe* with probability $1-p-q$, for $(p,q) \in [0,1]^2$ with $0 < p+q \leqslant 1$. A *move* involves relocating a token from where it is currently located, say a vertex u of T_χ, to any child v of u. Two players take turns to make moves, and a player wins if she is either able to move the token along an edge labeled a target, or force her opponent to move the token along an edge labeled a trap, or confine her opponent to a leaf vertex. We analyze the probability of win (respectively, loss) for the first player in terms of suitable fixed points of functions that involve the probability generating function of the offspring distribution χ. We also establish necessary and sufficient conditions for the probability of draw to be 0, and find precisely where, in terms of p, q and the underlying parameter(s) of χ, the probability of draw changes

from being 0 to being strictly positive (an important phase transition phenomenon), when χ belongs to one of the well-known classes of distributions (binomial, Poisson, negative binomial etc.).
We generalize the *bond percolation game* described above to *toll-tax games*: here, each edge (u, v) (with u being the parent of v) of T_χ is assigned, independently, a random weight $w(u, v)$, such that

$$\mathbf{P}[w(u,v) = 0] = p_0,\ \mathbf{P}[w(u,v) = 1] = p_1,\ \mathbf{P}[w(u,v) = -1] = p_{-1}$$

with $p_0 + p_{-1} + p_1 = 1$. Whenever a player moves the token along an edge (u, v), she is awarded an amount equal to $w(u, v)$. Given parameters $k_1, k_2 \in \mathbb{N}_0$ (not both of them simultaneously 0), and $i, j \in \mathbb{N}_0$ such that the player who moves first begins with an initial capital of amount i and her opponent begins with an initial capital of amount j, a player wins if she is the first to amass a capital of amount k_1 or her opponent is the first to have her capital dwindle to amount $-k_2$. Once again, we study the probabilities of win (for the first player), loss (for the first player) and draw in this game, and investigate possible phase transition phenomena pertaining to the probability of draw.

7. **Title:** Higher independence complexes of chordal graphs
Speaker: Amit Roy
Abstract: Given a finite simple undirected graph G there is a simplicial complex $\mathrm{Ind}(G)$, called the independence complex, whose faces correspond to the independent sets of G. For $r \geq 1$, a subset of the vertex set is called r-independent if the connected components of the induced subgraph have cardinality at most r. The collection of all r-independent subsets of G form a simplicial complex, called the r-independence complex and is denoted by $\mathrm{Ind}_r(G)$. In this talk we discusse the shellability and vertex decomposability property of r-independence complexes of chordal graphs.

8. **Title:** Blocking sets of secant lines in $\mathrm{PG}(n, q)$
Speaker: Binod Kumar Sahoo
Abstract: (Joint work with B. De Bruyn, P. Pradhan) Let $\mathrm{PG}(n, q)$, $n \geq 2$, denote the n-dimensional projective space defined over a finite field of order q. For a given nonempty set $\mathbb{L}$ of lines of $\mathrm{PG}(n, q)$, a set B of points of $\mathrm{PG}(n, q)$ is called an $\mathbb{L}$-*blocking set* if each line of $\mathbb{L}$ contains at least one point of B. The first step in the study of blocking sets is to determine the smallest cardinality of a blocking set and to characterize, if possible, all blocking sets of that cardinality. We shall consider quadrics $\mathcal{Q}$ in $\mathrm{PG}(n, q)$ that are nondegenerate and denote by $\mathcal{S}$ the set of all lines of $\mathrm{PG}(n, q)$ meeting $\mathcal{Q}$ in exactly two points. In this talk, we shall discuss the minimum size $\mathcal{S}$-blocking sets in $\mathrm{PG}(n, q)$.

9. **Title:** On the minimum cut-sets of the power graph of a finite cyclic group
Speaker: Sanjay Mukherjee
Abstract: The power graph $\mathcal{P}(G)$ of a finite group G is the simple graph with vertex set G, in which two distinct vertices are adjacent if one of them is a power of the other. For an integer $n \geq 2$, let C_n denote the cyclic group of order n and let r be the number of distinct prime divisors of n. For $r \leq 3$, the minimum cut-sets of $\mathcal{P}(C_n)$ are characterized in [Discrete Appl. Math. 266 (2019), 259–271]. In this talk, for $r \geq 4$, we identify certain cut-sets of $\mathcal{P}(C_n)$ such that any minimum cut-set of $\mathcal{P}(C_n)$ must be one of them. This is a joint work with Dr. Kamal Lochan Patra and Dr. Binod Kumar Sahoo.

Harmonic Analysis and PDE

1. Divyang Bhimani, IISER Pune
2. Jotsaroop Kaur, IISER Mohali
3. Manas Ranjan Sahoo, NISER Bhubaneswar
4. Prashanta Garain, IISER Berhampur
5. Sayan Bagchi, IISER Kolkata
6. Sombuddha Bhattacharyya, IISER Bhopal
7. Abhishek Das, NISER
8. Nurun Nesha, IISER Kolkata
9. Pranav Kumar, IISER Bhopal
10. Santosh Kumar Nayak, NISER
11. Suman Mukherjee, NISER
12. Surjeet Singh Choudhary, IISER Bhopal

1. **Title:** The heat equation associated to fractional harmonic oscillator
   Speaker: Divyang Bhimani
   Abstract: We establish some fixed-time decay estimates in modulation and Lebesgue spaces for the fractional heat propagator $e^{-tH^\beta}, t, \beta > 0$, associated with the harmonic oscillator $H = -\Delta + |x|^2$. We then prove some local and global wellposedness results for nonlinear fractional heat equations.
   The part of this work is joint work with R. Manna, F. Nicola, S. Thangavelu, S. I. Trapasso and M. Majdoub.

2. **Title:** Localisation for Schrodinger semigroup corresponding to the sub-Laplacian on Heisenberg Group
   Speaker: Jotsaroop Kaur
   Abstract: We will prove localisation estimates for solution of Schrodinger equation corresponding to the sub-Laplacian on the Heisenberg Group when the initial data is in a suitable Sobolev space.

3. **Title:** One-dimensional pressureless gas dynamics model in the quarter plane
   Speaker: Manas Ranjan Sahoo
   Abstract: In this talk, we address the solvability of the initial-boundary value problem for the one-dimensional pressureless gas dynamics equations. Using the method of generalized potentials and characteristic triangles, we obtain a Hopf-lax type formula that satisfies the Lax-entropy condition and a weak form of boundary condition. Further, we show that the solution conserves mass, and the conservation of momentum depends on the behavior of the generalized boundary potentials.

4. **Title:** Regularity theory for mixed local and nonlocal elliptic problems.
   Speaker: Prashanta Garain
   Abstract: We consider a combination of local and nonlocal quasi-linear elliptic equations. We will discuss several regularity properties of solutions for such equations. More precisely, we will discuss local boundedness, Harnack's inequality among other qualitative properties. The results capture both local and nonlocal features of the equation.

5. **Title:** On pseudo-multipliers associated to Grushin operators
   Speaker: Sayan Bagchi
   Abstract: We shall discuss our recent results on Grushin pseudo-multipliers. This talk is based on joint works with Riju Basak, Rahul Garg and Abhishek Ghosh.

6. **Title:** Inverse Problems for PDEs
Speaker: Sombuddha Bhattacharyya
Abstract: In this talk we will discuss the famous Calderón problem (1980), which concerns a linear elliptic second order partial differential operator defined on a bounded domain. The problem at large is open but there has been some significant developments in the last 30 years. We will discuss a method of approaching the problem using geometric optics solutions and integral equations. Further, we will address few generalizations of the Calderón problem and some contributions from Indian mathematicians towards that.
Keywords: Inverse Problems, Elliptic PDEs, Geometric Optics, Integral Equations.

7. **Title:** Explicit structure of wave interaction in the one-dimensional zero-pressure gas dynamics system
Speaker: Abhishek Das
Abstract: In this talk, we are going to consider the one-dimensional zero-pressure gas dynamics system
$$u_t + \left(u^2/2\right)_x = 0,\ \rho_t + (\rho u)_x = 0$$
in the upper-half plane under the condition that the initial data at $t = 0$ is a linear combination of two δ-distributions
$$u|_{t=0} = u_a\ \delta_{x=a} + u_b\ \delta_{x=b},\ \rho|_{t=0} = \rho_c\ \delta_{x=c} + \rho_d\ \delta_{x=d}.$$
Here a, b, c, d are distinct points on the real line ordered as $a < c < b < d$ and u_a, u_b, ρ_c, ρ_d are real constants.
Our objective is to study the corresponding modified adhesion model
$$\begin{aligned} u^\epsilon_t + \left((u^\epsilon)^2/2\right)_x = \frac{\epsilon}{2} u^\epsilon_{xx},\ \rho^\epsilon_t + (\rho^\epsilon u^\epsilon)_x = \frac{\epsilon}{2}\rho^\epsilon_{xx},\\ u^\epsilon|_{t=0} = u_a\ \delta_{x=a} + u_b\ \delta_{x=b},\\ \rho^\epsilon|_{t=0} = \rho_c\ \delta_{x=c} + \rho_d\ \delta_{x=d} \end{aligned}$$
and understand the passage to the limit of $(u^\epsilon, \rho^\epsilon)$ as ϵ approaches 0.

8. **Title:** Differential Inclusions involving the curl operator
Speaker: Nurun Nesha
Abstract: We show that there does not exist any $u \in W^{1,\infty}_0(\Omega;\mathbb{R}^n)$ of the following differential inclusion problem
$$\operatorname{curl} u \in E \quad \text{a.e. in } \Omega \qquad (\circledast)$$
if we take $\dim \operatorname{span} E = n$ and we expect $\int\limits_\Omega u \neq 0$ and $\operatorname{meas}\{x \in \Omega : \operatorname{curl} u(x) = e\} > 0$ for all $e \in E$.
Furthermore, we will show that there does not exist any $u \in W^{1,\infty}_0(\Omega;\mathbb{R}^n)$ of $(\circledast)$ if $\dim \operatorname{span} E \geq n+1$ where $E \subseteq \Lambda^2(\mathbb{R}^n)$ has one particular property that for $e, f \in E$, there exist $m, n \in \mathbb{R}^n$ such that $e - f = m \wedge n$. In other words, $\operatorname{rank}_1[e-f] \leq 2$ for any $e, f \in E$.

9. **Title:** The Calderón inverse problem for polyharmonic operators with partial data
Speaker: Pranav Kumar
Abstract: In this talk, we discuss the partial data Calderón inverse problem for polyharmonic operators in a bounded domain. We prove the unique determination of all the coefficients of the operator from the knowledge of the Dirichlet and Neumann map on the same part of the boundary, under the suitable geometric assumptions on the domain.

10. **Title:** Weyl transform on some nonunimodular Groups
Speaker: Santosh Kumar Nayak
Abstract: For $p > 2$, B. Simon studied the unboundedness of the Weyl transform for symbol belonging to $L^p(\mathbb{R}^n \times \mathbb{R}^n)$. In this talk, we study the analog of unboundedness of the Weyl transform on some nonunimodular groups, namely, the affine group, similitude group, and affine Poincaré group.

11. **Title:** Weighted Inequalities for Multilinear Fractional Operators in Dunkl Setting
Speaker: Suman Mukherjee
Abstract: Dunkl theory is a generalization of Fourier analysis and special function theory related to root systems and reflection groups. For a fixed root system R on $\mathbb{R}^d$ and a fixed non-negative multiplicity function k, the Dunkl operators,

$$T_\xi f(x) := \partial_\xi f(x) + \sum_{\lambda \in R} \frac{k(\lambda)}{2} \langle \lambda, \xi \rangle \frac{f(x) - f(\sigma_\lambda x)}{\langle \lambda, x \rangle},$$

were introduced by Charles Dunkl [1] in 1989. They can be treated as generalizations of the ordinary directional derivatives and they inherit some of their key properties. It turns out that the Dunkl operators are very important tools in the study of special functions with reflection symmetries and allow one to built up a framework for Fourier analysis in the Dunkl setting. The goal of this talk is to study Dunkl counterparts of the multilinear fractional integral operators and the multilinear fractional maximal function operators, introduced by Moen [2] in the classical setting. In the first part of the talk we will recall some preliminaries of Dunkl analysis and then we will present the main results. This is based on a joint work [3] with Dr. Sanjay Parui.
References:
(1) C. F. Dunkl. Differential-difference operators associated to reflection groups. Trans. Amer. Math. Soc., **311**(1):167–183, 1989.
(2) K. Moen. Weighted inequalities for multilinear fractional integral operators. Collect. Math., **60**(2):213–238, 2009.
(3) S. Mukherjee and S. Parui. Weighted inequalities for multilinear fractional operators in Dunkl setting. J. Pseudo-Differ. Oper. Appl., **13**(3):Paper No. 34, 31 pp., 2022.

12. **Title:** Bilinear Kakeya maximal function on the plane
Speaker: Surjeet Singh Choudhary
Abstract: For a collection $\mathfrak{F}$ of sets, the maximal averaging operator defined as

$$M_{\mathfrak{F}} f(x) := \sup_{F \in \mathfrak{F}: x \in F} \frac{1}{|F|} \int_F |f(y)| \, dy$$

plays an important role in analysis. When $\mathfrak{F}$ is the collection of balls or cubes in $\mathbb{R}^2$, the L^p- boundedness of the Hardy-Littlewood maximal function $M_{\mathfrak{F}}$ is well known. $M_{\mathfrak{F}}$ fails to be L^p bounded for $1 \leq p \leq \infty$, if $\mathfrak{F}$ is the collection of all rectangles in $\mathbb{R}^2$. Whereas if we restrict the collection to rectangles of a fixed eccentricity (i.e. the ratio of the longer side to the shorter side of the rectangle), $M_{\mathfrak{F}}$ is L^p bounded with bounds depending logarithmically on the eccentricity. In this talk, we consider the bilinear analogue of such operators defined as

$$M_N(f,g)(x) = \sup_{R \in B_N, (x,x) \in R} \frac{1}{|R|} \int_R |f(y_1)| \, |g(y_2)| \, dy_1 dy_2$$

where the B_N is collection of rectangles with fixed eccentricity N in $\mathbb{R}^2$. We will discuss the $L^p \times L^q \to L^r$ bounds of M_N. (This is a joint work with Ankit Bhojak and Saurabh Shrivastava.)

Number Theory

1. Anilatmaja Aryasomayajula, IISER Tirupati
2. Chandrakant S Aribam, IISER Mohali
3. Karam Deo Shankhadhar, IISER Bhopal
4. Prem Prakash Pandey, IISER Berhampur
5. Shalini Bhattacharya, IISER Tirupati
6. Soumya Bhattacharya, IISER Kolkata
7. Gargi Mukherjee, NISER Bhubaneswar
8. Jewel Mahajan, IISER Pune
9. Mithun Kumar Das, NISER
10. Sandeep E M, NISER
11. Shivansh Pandey, NISER

1. **Title:** Estimates of Siegel cusp forms in genus 2
   Speaker: Anilatmaja Aryasomayajula
   Abstract: In this talk, we describe a method to derive estimates of Hecke eigen Siegel cusp forms in genus 2. The method involves a combination of the amplification technique introduced by Blomer and Pohl in 2016, and heat kernel analysis coming from complex geometry. This is joint work with my student Mr. Harinarayanan, and it is part of his PhD thesis.

2. **Title:** Euler systems for some elliptic curves with a p-isogeny
   Speaker: Chandrakant S Aribam
   Abstract: For an elliptic curve with an isogeny of degree p, we present the Euler systems that are related to special values of L-functions of elliptic curves.

3. **Title:** Distinguishing Siegel eigenforms
   Speaker: Karam Deo Shankhadhar
   Abstract: In this talk, we discuss strong multiplicity one result for Siegel eigenforms of degree two. Next, we distinguish these Siegel eigenforms by the signs of their eigenvalues. This is based on joint works with Arvind Kumar and Jaban Meher.

4. **Title:** A novel approach to study class groups
   Speaker: Prem Prakash Pandey
   Abstract: Class groups of number fields are among most important objects studied in algebraic number theory. For any number field K, its class group $C\ell(K)$ is the quotient of the free abelain group generated by non-zero prime ideals of K, by the subgroup of non-zero principal ideals.
   For cyclotomic fields of prime conductor, it was shown by Kummer that the prime ideals of degree one generate the class group. Later, using analytic techniques, it was shown that this holds true for any number field. Further, the density of prime ideals of degree one among all prime ideals is 1. Due to these, to study class groups the use of prime ideals of degree one is a natural choice.
   In a series of works, we show that primes of higher degree also can be explored to study class groups of number fields. In particular, we have shown that there are many number fields whose class group is generated by prime ideals of a fixed degree bigger than one. These are used to construct relative annihilators of class groups and obtain some results on class groups. Some of these are joint works with Dr. Mahesh Kumar Ram and with Mr. Nimish Kumar Mahapatra.

5. **Title:** Computing local Galois representations modulo 2
Speaker: Shalini Bhattacharya
Abstract: We will describe the problem of mod p reduction of p-adic Galois representations for any prime p. For two dimensional crystalline representations of the local Galois group $\mathrm{Gal}(\overline{\mathbb{Q}}_p|\mathbb{Q}p)$, the reduction can be computed using the compatibility of p-adic and mod p Local Langlands Correspondences; a method introduced by Christophe Breuil in 2003. For p odd, the shape of the reductions are now explicitly known for a range of small slopes by the works of Buzzard-Gee, and Ghate and coauthors. However, very little is known about the special case of the smallest prime 2. After giving a sketch of the background and history of the problem, we will report on an ongoing project (joint with Arathy Venugopal) on reduction mod 2 of Galois representations.

6. **Title:** Unique identification of irreducible holomorphic eta quotients
Speaker: Soumya Bhattacharya
Abstract: It is well-known that an eta quotient of level N is uniquely identified by its orders of vanishings at the cusps $1/d$ of $\Gamma_0(N)$, where $d|N$. It is natural to ask whether it would be possible to identify an eta quotient from such information obtained from an even smaller set of cusps. Indeed, we found a bijective correspondence between the set of Atkin-Lehner involutions of level N and the set of nontrivial entries on the diagonal of a canonical form of the order matrix of level N (i.e. the matrix whose entries are orders of vanishing of $\eta(dz)$ at the cusp $1/d'$ of $\Gamma_0(N)$, where both d and d' are divisors of N). It follows from the above correspondence that an irreducible holomorphic eta quotient of level N is uniquely determined by the orders of vanishings of its images under the Atkin-Lehner involutions of level N at the cusp ∞. This is equivalent to say that an irreducible holomorphic eta quotient of level N is uniquely determined by its orders of vanishings only at those cusps of $\Gamma_0(N)$ which are represented by the reciprocals of the squarefree divisors of N.

7. **Title:** Asymptotics and reverse higher order Turán inequality related to overpartition function
Speaker: Gargi Mukherjee
Abstract: Let $\overline{p}(n)$ denote the overpartition function. In this talk, we study the asymptotic growth of $(-1)^r\Delta^r \log \sqrt[n]{\overline{p}(n)/n^\alpha}$, for α being a non-negative real number, by presenting an inequality of it with a symmetric upper and lower bound. Consequently, we arrive at log-convexity of $\sqrt[n]{\overline{p}(n)}$ and $\sqrt[n]{\overline{p}(n)/n}$. Also we introduce the notion of the reverse higher order Turán inequality and prove this for $\sqrt[n]{\overline{p}(n)/n^\alpha}$, which depicts the non real-rootedness of the Jensen polynomial associated with the sequence mentioned before.

8. **Title:** Higher moments of the pair correlation function for Sato-Tate sequences
Speaker: Jewel Mahajan
Abstract: In the paper "Pair correlation statistics for Sato–Tate sequences", Balasubramanyam and Sinha derived the first moment of the pair correlation function for Hecke angles lying in small subintervals of $[0, 1]$, as one averages over large families of Hecke newforms of weight k with respect to $\Gamma_0(N)$. In this talk, we will see results for higher moments of this pair correlation function. As an immediate consequence of this, we see that the variance goes to 0 under the same growth conditions on weights and levels for the families of Hecke newforms as required for the convergence of the first moment. This is joint work with Kaneenika Sinha.

9. **Title:** Higher dimensional Poissonian pair correlation
Speaker: Mithun Kumar Das
Abstract: In this talk, we shall discuss the concept of pair correlation statistic in higher dimension. We will demonstrate that for any d-dimensional sequence in $\mathbb{N}^d$ with coordinates are strictly increasing, has *metric Poissonian pair correlation* with respect to sup-norm (and 2-norm) if their *joint additive energy* is $\ll N^{3-\delta}$ for any $\delta > 0$. A significant implication of this finding is that it provides negative answer to a question raised by Hofer and Kaltenböck. This is joint work with T. Bera and A. Mukhopadhyay.

10. **Title:** Zero free regions of spectral averages of Hecke-Maass L-functions
Speaker: Sandeep E M
Abstract: Since the time of Riemann (1859), non-vanishing of L-functions has been an interesting area of research in analytic number theory. Later, once the theory of automorphic forms began developing systematically under the shoulders of Ramanujan, Hecke, Siegel, Selberg (to name a few), number theorists started looking at the L-functions associated to such forms.
In this talk, I would describe a recent result on the zero-free region of certain weighted average of L-functions of integral weight Hecke-Maass cusp forms of weight zero. Prior to that, similar results obtained for those corresponding to holomorphic Hecke cusp forms (we will stick to level 1 in both cases) would also be briefed. The latter is a joint work with Dr. Satadal Ganguly.

11. **Title:** L-functions for Jacobi forms of half integral weight
Speaker: Shivansh Pandey
Abstract: Jacobi forms are natural generalization of modular forms and they play an important role in the proof of Saito-Kurokawa conjecture. R. Berndt [1] associated a set of $2m$ L-functions to a Jacobi form of weight k and index m. Y. Martin [2] studied analytic continuation and converse theorem for these functions. In this talk we shall discuss analytic continuation for L-functions of half integral weight Jacobi forms and study converse theorem for these L-functions. This talk is based on a joint work with Dr. Brundaban Sahu and Dr. Abhash Kumar Jha.
References:
(1) R. Berndt, L-functions for Jacobi cusps forms à la Hecke, *Maniscripta Math.*, **84** (1994), 101–112.
(2) Yves Martin, A converse theorem for Jacobi forms, *J. Number Theory*, **61** (1996), 181–193.
(3) Y.Tanigawa, Modular descent of Siegel modular forms of half-integral weight and an analogy of the Maass relation, *Nagoya Math. J.*, **102** (1986), 51–77.

Topology and Geometry

1. Arjun Paul, IISER Kolkata
2. Mainak Poddar IISER Pune
3. Sanjay Kumar Singh, IISER Bhopal
4. Soma Maity, IISER Mohali
5. Debattam Das, IISER Mohali
6. Neeraj Kumar Dhanwani, IISER Mohali
7. Sandip Samanta, IISER Kolkata
8. Subham Sarkar, NISER Bhubaneswar

1. **Title:** Real parabolic connections.
   Speaker: Arjun Paul
   Abstract: We define the notion of real structure on parabolic bundle equipped with a parabolic connection, and relate it with the real structure on logarithmic connection on the associated orbifold bundle on a root stack.

2. **Title:** Logarithmic connections on algebraic principal bundles
   Speaker: Mainak Poddar
   Abstract: The study of logarithmic connections on vector bundles over a smooth variety with poles along a normal crossing divisor was initiated by Deligne and has applications to the Riemann-Hilbert correspondence, vanishing theorems, etc. We develop a notion of logarithmic connection on a principal bundle over a normal algebraic variety, with poles along a reduced Weil divisor. We show that the existence of such a connection on a principal bundle over a toric variety is equivalent to the existence of a torus equivariant structure on the bundle, generalizing results of Biswas et al. in the holomorphic case. This is based on a joint work with Jyoti Dasgupta and Bivas Khan.

3. **Title:** Parabolic Sheaves on an Integral Projective Curve
   Speaker: Sanjay Kumar Singh
   Abstract: Mehta and Seshadri proved that the set of equivalence classes of irreducible unitary representations of the fundamental group of a punctured compact Riemann surface could be identified with the set of equivalence classes of stable parabolic bundles of parabolic degree zero on the compact Riemann surface. In this talk, we discuss the Mehta–Seshadri correspondence over an irreducible projective curve with at most nodes as singularities. This is joint work with C. Arusha.

4. **Title:** Volume Growth on manifolds with more than one ends
   Speaker: Soma Maity
   Abstract: The volume growth function of a Riemannian manifold of bounded geometry is a function having bounded growth of derivative or bgd-function in short. Grimaldi and Pansu showed that any one-ended finite type manifold admits a metric such that the volume growth function has a growth type of a given bgd-function. In the case of one-ended manifolds of infinite type, they showed that the same thing holds if and only if a bgd-function v satisfies $\lim_{n\to\infty} \frac{v(n)}{n} = +\infty$. We generalize this result to manifolds with finitely many ends and show that a manifold with infinitely many ends does not admit any metric with bounded geometry such that the volume growth function belongs to the class of any polynomial. We also show that on certain manifolds with countably many ends there exist metrics such that the volume growth functions have growth type arbitrarily close to that of any predetermined bgd-function. This is a joint work with Anushree Das.

5. **Title:** Reciprocity in the Hecke Groups
Speaker: Debattam Das
Abstract: An element g in a group G is called *reciprocal* if there exists $h \in G$ such that $g^{-1} = hgh^{-1}$. The reciprocal elements are also known as 'real elements' or 'reversible elements' in the literature. We have classified and parametrized the reciprocal classes in the Hecke groups. This generalizes a result by Sarnak on the reciprocal elements in the modular group. This is joint work with my supervisor, Dr. Krishnendu Gongopadhyay.

6. **Title:** Writing periodic mapping classes into product of Dehn twists
Speaker: Neeraj Kumar Dhanwani
Abstract: Let $\mathrm{Mod}(S_g)$ be the mapping class group of the closed orientable surface S_g of genus $g \geq 1$. In this talk, we will discuss various methods for expressing periodic mapping classes as a product of Dehn twists, up to conjugacy. These methods are based on the chain and star relations in the mapping class group, the geometric realizations, and the symplectic representations of periodic elements.

7. **Title:** Splitting of Fibration and Brace Product
Speaker: Sandip Samanta
Abstract: We can explore the question of whether a given fibration $F \hookrightarrow E \to B$ splits by considering its associated loop space fibration $\Omega F \hookrightarrow \Omega E \to \Omega B$. This alternative approach allows us to examine the relationship between the brace product, originally introduced by James for a fibration with a section, and the splitting of the loop space fibration.
By investigating the splitting of the loop space fibration $\Omega F \hookrightarrow \Omega E \to \Omega B$, we can gain insights into the original question of whether the fibration $F \hookrightarrow E \to B$ splits. Various results have been established concerning the splitting of the loop space fibration, and these findings can be employed to shed light on the original inquiry.

8. **Title:** A base change version of Rasmussen-Tamagawa Conjecture
Speaker: Subham Sarkar
Abstract: We introduce the notion of m-compatible system of ℓ-adic representations of absolute Galois group of a number field K and prove a certain uniform version of Shafarevich Conjecture, motivated by the Rasmussen-Tamagawa Conjecture. As a corollary, we prove the Rasmussen-Tamagawa Conjecture for a particular class of abelian varieties A defined over a number K of dimension g having everywhere potential good reduction, in particular, for any finite place v of K the localization $A_v := A \times_{\mathrm{Spec}(K)} \mathrm{Spec}(K_v)$ has either good reduction or totally bad reduction and has good reduction over a quadratic extension of K_v.