



Department Research Showcase Mathematics Open House November 25, 2023

Who Are We? A bit of History: <u>https://iiitd.ac.in/about</u>

- Indraprastha Institute of Information Technology Delhi (IIIT-Delhi) was created by an act of Delhi legislature empowering it to carry out R&D, conduct educational programs, and grant degrees.
- IIIT-Delhi is accelerating on the path of becoming one of the leading comprehensive research-led teaching institutes in India and has proven to be consistently responsive towards the evolving needs of society.
- The faculty members at IIIT-Delhi are among the finest in the country and are internationally recognized. Carrying out cutting-edge research is in the institutional DNA of IIIT-Delhi.
- The Institute is currently celebrating its 15th year of excellence.



Who Are We? A bit of History: https://math.iiitd.ac.in

- The Department of Mathematics was set up in the year 2017
- We are currently a group of
 - 13 regular faculty members
 - 3 faculty members with Mathematics as secondary affiliation
 - 2 visiting faculty members
- We offer the following two programs
 - B.Tech. in Computer Science and Applied Mathematics
 - 4 batches of students and about 278 students have graduated (Nov. 2023)
 - Ph.D. in Mathematics
 - 4 students have graduated (Nov. 2023)
 - Total of 6 Ph.D.s advised by Math faculty (Nov. 2023)
- We are a young, vibrant, and thriving Department!

Vision

The Department of Mathematics envisions becoming globally recognised and respected for research and education in Mathematical Sciences.

Mission

The Department of Mathematics aims to achieve its Vision through the following broad goals:

- Create an inclusive and vibrant environment for research and education in Mathematical Sciences,
- Equip students with analytical skills to help find solutions to real world problems,
- Engage with partners in collaborative endeavours for development and application of new knowledge.

Faculty Members

13 Regular Faculty Members:

- 1 Professor
- 2 Associate Professors
- 10 Assistant Professors
- 3 Faculty with Joint Affiliation :
- 3 Associate Professors
- 2 Visiting Faculty Members:
- 1 Professor
- 1 Lecturer

Students

B.Tech. Students in CSAM:

• Four batches and a total of 278 students have graduated

Ph.D. Students in Mathematics:

- 23 Currently working with Math faculty members
- 6 Doctoral Degrees Awarded

Postdoctoral Fellows:

- 1 Currently
- 5 Previously

Faculty Members Research Areas (Not Exhaustive!)

- Algebra
- Algebraic Geometry
- Algorithms and Approximations
- Applied and Computational Topology
- Coding Theory
- Cryptography
- Combinatorics
- Computational Geometry
- Differential Geometry
- Fluid Dynamics
- Functional Analysis
- Harmonic Analysis

- High Performance Computing
- Mathematical Foundations and Logic
- Mathematics of Biology
- Mathematics of Computer Graphics
- Machine Learning Theory
- Number Theory
- Operator Algebras and Theory
- Optimal Control
- Optimization
- Partial Differential Equations
- Quantum Information Theory
- Statistics

- Prof. Anuradha Sharma
- Dr. Ashish Kumar Pandey
- Dr. Debika Banerjee
- Dr. Donghoon Chang (On Leave)
- Dr. Kaushik Kalyanaraman
- Dr. Monika Arora
- Dr. Nabanita Ray
- Dr. Ojaswa Sharma
- Dr. Prahllad Deb

- Dr. Rajiv Raman
- Dr. Samrith Ram (On Leave)
- Dr. Sankha Basu
- Dr. Sarthok Sircar
- Dr. Satish Kumar Pandey
- Dr. Sneha Chaubey
- Prof. Samaresh Chatterji
- Dr. Subhajit Ghosechowdhury
- Dr. Subhashree Mohapatra

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- Dr. Prahllad Deb

Regular Faculty Members

- Dr. Rajiv Raman
- Dr. Samrith Ram (On Leave)
- Dr. Sankha Basu
- Dr. Sarthok Sircar
- Dr. Satish Kumar Pandey
- Dr. Sneha Chaubey
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- Dr. Subhashree Mohapatra

Regular Faculty Members Faculty Members with Secondary Affiliation Visiting Faculty Members

- Prof. Anuradha Sharma
- Dr. Ashish Kumar Pandey
- Dr. Debika Banerjee
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Leaning Theoretical Researchers

- Prof. Anuradha Sharma
- **Dr. Ashish Kumar Pandey**
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Leaning Applied Researchers

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Algebra, Number Theory, and Allies

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Algebra, Number Theory, and Allies

Analysis, Geometry, and Allies

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Algebra, Number Theory, and Allies

Analysis, Geometry, and Allies

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Statistics

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Algebra, Number Theory, and Allies

Analysis, Geometry, and Allies

Foundational

Statistics

Faculty Members and their Research Areas: Regular Faculty Members of Mathematics

Prof. Anuradha Sharma

- Has B.Sc. degree with Honors in Mathematics, and M.Sc. and Ph.D. degrees in Mathematics from Centre for Advanced Study in Mathematics, Panjab University
- She works primarily in the area of **Coding Theory**, which deals with the design and study of error-correcting codes for reliable transmission of data across noisy communication channels
- Algebra, Number Theory, Combinatorics and Geometry play a significant role in the design and study of error-correcting codes where many deep results from these areas are being used in elegant ways
- She has introduced and studied several important and algebraically rich families of error-correcting codes based on finite twisted group algebras, and explored their connections with the theory of unimodular lattices and modular forms
- She takes teaching as the best learning opportunity for herself, and a motivation for choosing an academic career





Dr. Ashish Kumar Pandey

- Has 5-year integrated B.Sc.-M.Sc. from National Institute of Science Education and Research (NISER), Bhubaneswar, and Ph.D. from the University of Illinois at Urbana Champaign
- His primary research is in **partial differential equations** and applies his knowledge of mathematics to solve problems related to different domains for example shallow water waves, tropical cyclones, neonatal health, auctions, and machine learning
- He studies the stability of solutions of these PDEs and derives expressions whose sign determines the stability versus instability
- In Machine Learning, he is interested in both application as well as theoretical aspects of machine learning
- He primarily teaches courses in analysis and differential equations

Dr. Debika Banerjee

- Obtained her Masters from IIT Kanpur, and Ph.D. from Harish-Chandra Research Institute, Allahabad
- Her research interests are Analytic and Probabilistic Number Theory
- She is primarily interested in analytic number theory, probabilistic number theory and special functions
- More particularly in analytical aspects of arithmetical functions, divisor and circle problems, exponential sums, integral transform, multiple zeta functions and partition theory
- She believes that Mathematics is one of the most challenging and demanding subjects for the students and, as a result, for the instructor as well





Dr. Kaushik Kalyanaraman

- Obtained B.E. in Electrical and Electronics Engineering from Anna University, Chennai, M.Tech. in Electrical Engineering from IIT Bombay, and Ph.D. in Computer Science from the University of Illinois at Urbana-Champaign
- Thinks of himself to be an **Applied and Computational Mathematician** with research interests in Applied and Computational aspects of Analysis, Geometry and Topology
- Primarily interested in structure preserving finite element solution of elliptic partial differential equations including Maxwell's equations, discrete differential geometry, applied and computational topology, and applications of these to areas like Graphics and Machine Learning
- Tries to learn Mathematics by teaching Mathematics, and is interested in teaching courses with a computational and/or geometric core component

Dr. Monika Arora

- Has Masters in Applied Statistics and Informatics (ASI) from IIT Bombay, and Ph.D. in Computational and Applied Mathematics from Old Dominion University
- Her current research areas are **count data**, **statistical modeling**, **statistical inference**, **distribution theory**, **data science**, and **stochastic processes**
- Her research involves both theoretical and computational techniques to develop the models
- She uses both classical statistical methods and data science approaches for her work
- Her teaching interests are mainly in courses in Probability and Statistics, and she emphasizes both theory and real-life applications while teaching





Dr. Nabanita Ray

- She received her bachelor's and master's degrees from Jadavpur University, Kolkata and obtained her Ph.D. from The Institute of Mathematical Sciences, Chennai
- Her research interest is in **Algebraic Geometry**, more specifically Positivity problems in Algebraic Geometry and properties of vector bundles
- Algebraic Geometry is one of the research domains where we use the preciseness of algebraic results to prove geometric properties
- She likes to study the embedding of geometric objects (more specifically, algebraic varieties) and vector bundle's stability and semi-stability properties
- She enjoys teaching Algebra, Analysis, Geometry, Topology, and likes to train students in mathematical writing by giving homeworks

Dr. Prahllad Deb

- Obtained his Ph.D. in the year 2020 from Indian Institute of Science Education and Research, Kolkata
- His research interests broadly fall into the field of **functional analysis**, **complex function theory** and **differential geometry**
- More concretely, he is now interested in free noncommutative function theory, homogeneous Cowen-Douglas operators and differential geometry
- He likes to study differential geometric invariants (for example, Chern connection, Curvature, etc.) for noncommutative vector bundles, homogeneous operator tuples in the noncommutative Cowen-Douglas class, and notion of noncommutative bounded symmetric domains to name a few
- He likes to spend time by doing mathematics, and believes that teaching gives him an unparalleled opportunity to fulfill this desire





Dr. Samrith Ram (On Leave)

- Obtained his Ph.D. in Mathematics from IIT Bombay, India
- His research interests are **algebraic and enumerative combinatorics** in the setting of **finite fields**
- His primary focus has been on enumeration problems arising in cryptography in particular a problem of Niederreiter on splitting subspaces
- He is currently working in enumerative and algebraic combinatorics in the setting of finite fields
- He is passionate about fostering a transformative learning experience, and utilizes student-centered approaches to ignite curiosity, and empower each individual to reach their full potential

Dr. Sankha Basu

- Obtained his Ph.D. from The Pennsylvania State University
- His research interests are Mathematical Logic and Foundations of Mathematics
- His focus is on non-classical logics that deviate from and augment classical reasoning where it falls short or doesn't lead to satisfactory outcomes
- He is actively pursuing Paraconsistent logics which do not allow everything to follow from a contradiction; Intuitionistic logic, a constructive logic, which among other things, do not allow one to assert statements of the form 'A or not-A' for an arbitrary A; and Universal logic which aims to study logics as structures in the sense of Bourbaki
- He believes that teaching mathematics and logic offers a unique opportunity to share the excitement of the subject with students





Dr. Sarthok Sircar

- He obtained his Ph.D. in Mathematics from the University of South Carolina
- His main mathematical interests are in the development and analysis of **nonlinear hyperbolic and elliptic partial differential equations** with applications which lie at the interface of applied mathematics and **biology**
- He is particularly interested in solving problems involving soft matter and fluid flow using asymptotic and perturbation methods, numerical approximation and statistical mechanics
- He strongly believes that a close contact with experimentalists is absolutely crucial and this is reflected in the nature of his current projects on Particle adhesion and fragmentation, Polyelectrolyte gels, and future plans to work on Active materials, Gastric gels, and Cystic fibrosis
- He uses a variety of tools including perturbation techniques, linearization and direct numerical simulation in his model development

Dr. Satish Kumar Pandey

- Earned his Ph.D. in Pure Mathematics at University of Waterloo
- His general field of research interest is **Operator Theory** and **Operator Algebras**
- He is also investigating the application of Reproducing Kernel Hilbert Space techniques in Quantum Information Theory
- He categorises his entire research into two parts: Operator Theory (univariate and multivariate)/Operator Algebras, and Operator Algebra techniques in Quantum Information Theory
- He subscribes to an old adage that if you want to master something you have to teach it, and that he has a lot to master and therefore must teach a lot





Dr. Sneha Chaubey

- Obtained her Ph.D. from the University of Illinois at Urbana-Champaign
- Her research interests lie in **number theory** and **its interplay** with **algebra**, **analysis**, and **dynamics**
- The problems she has focused on in her research have been motivated by questions on the distribution of sequences which appear naturally in problems in number theory; specifically the distribution of zeros of L-functions, pseudorandom properties of point sequences, distribution of arithmetic functions and arithmetic aspects of circle packings
- She believes teaching to be quite rewarding, and wants to be able to convey something she has understood and help students proceed to that stage of understanding

Dr. Subhashree Mohapatra

- Obtained her Ph.D. from Indian Institute of Technology, Kanpur
- Her research interests are **High order schemes for numerical solution of partial** differential equations, Optimal control theory, Parallel implementation of computational fluid dynamics related problems
- She primarily focuses on high order numerical solvers for partial differential equations and their parallel implementation
- Recently, her main focus has been spectral element formulation for Stokes and Navier-Stokes equations for which she is developing a software package
- She aims towards exposing the young vibrant minds to the world of basic and computational mathematics and emphasizes to learn with fun in the classroom



Faculty Members and their Research Areas: Faculty Members with Joint Affiliation

Dr. Donghoon Chang (On Leave)

- Has Bachelor of Mathematics, Master of Information Security & Cryptography, and Ph.D. of Information Security & Cryptography from Korea University
- His research interests are in **Cryptography**, **Cryptography**, **Biometric Security**, **Blockchain**, **IoT Security**
- He has a strong academic background in cryptographic technology as well as industrial R&D experiences in the applications of cryptography
- He has been serving in leadership position for promoting India-Korea R&D collaboration from government, academic, and industrial levels for both nations
- His teaching philosophy is that an instructor should not teach only inside classrooms but also encourage and help students to do more practical research





Dr. Ojaswa Sharma

- Has a Ph.D. in Mathematics and Computer Science from the Technical University of Denmark
- His research spans various aspects of **computer graphics**, and **computational geometry**
- In particular his work focuses on virtual/augmented reality, volume rendering, 3D surface reconstruction, and high performance computing on GPU.
- He looks at innovating autonomous systems for spatial computing by designing new algorithms and systems to reduce tedious manual effort
- A primary thrust of my ongoing research is on AI-based automatic geometry creation, and algorithms for visualization
- He believes that teaching should be student focussed and understanding the needs of students is important in deciding a teaching style and content delivery

Dr. Rajiv Raman

- Obtained his Ph.D. in Computer Science from the University of Iowa
- His primary area of research is Algorithms and Discrete mathematics
- His work has been in the area of graph algorithms, and discrete and computational geometry
- In the recent past, he has been working on developing analysis techniques for simple algorithms for basic geometric packing and covering problems
- He teaches courses in Discrete Mathematics, Randomized algorithms, Linear and Combinatorial Optimization



Faculty Members and their Research Areas: Visiting Faculty Members

Prof. Samaresh Chatterji

- He obtained his Ph.D. in Mathematics from Wayne State University
- His research and teaching interests are in **algebra** and **discrete mathematics**
- In his teaching, he has tried to convey the passion for the subject which has been a major driving force in his life





Dr. Subhajit Ghosechowdhury

- Obtained his Ph.D. in Mathematics from Purdue University
- His research interest is the interplay between Functional Analysis and Complex Analysis
- He has worked on structure theory of reproducing kernel Hilbert spaces related to the proof of Bieberbach conjecture
- He tries to follow a modified version of Moore's philosophy of teaching: "I hear, I forget; I see, I remember; I do, I understand"

Summary

- We are a diverse group of researchers in Mathematics yet with a cohesive agenda.
- Our Ph.D. program is young but already quite impactful and successful
 - All six of the Ph.D. students who have graduated by working with Mathematics faculty members are now pursuing the postdoctoral fellowship in various top places in India and outside
 - Our Ph.D. alumni are currently in Australia, India, and United States
- We are happy to engage with you all, and we are easily reachable through our contact information <u>https://math.iiitd.ac.in/math-faculty.html</u>.
- Feel free to contact any of us to discuss more about advice, collaboration, and other opportunities.

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Ms. Risha D'Cruz

- Is the Assistant Manager of the Department
- Has been around longer in the Department than most of the faculty members!
- She can be reached in case you need to set up appointments with any of us faculty members and for some reason we are not reachable ourselves Email: office-maths@iiitd.ac.in



Thank You to the IIIT-Delhi Family!

- On behalf of the Department of Mathematics, we wish to thank Prof. Ranjan Bose, Director, IIIT-Delhi for all the encouragement, moral and financial support always extended to us.
- We are also thankful to all the Administrative Officers, Deans, Heads, and Staff across various Departments and Offices of the Institute for their overwhelming efforts in the smooth functioning of our work life.
- We gratefully acknowledge support for this Mathematics Open House from the Department Development Fund of the Institute.

Thank You All So Much!



INDRAPRASTHA INSTITUTE of INFORMATION TECHNOLOGY **DELHI**

