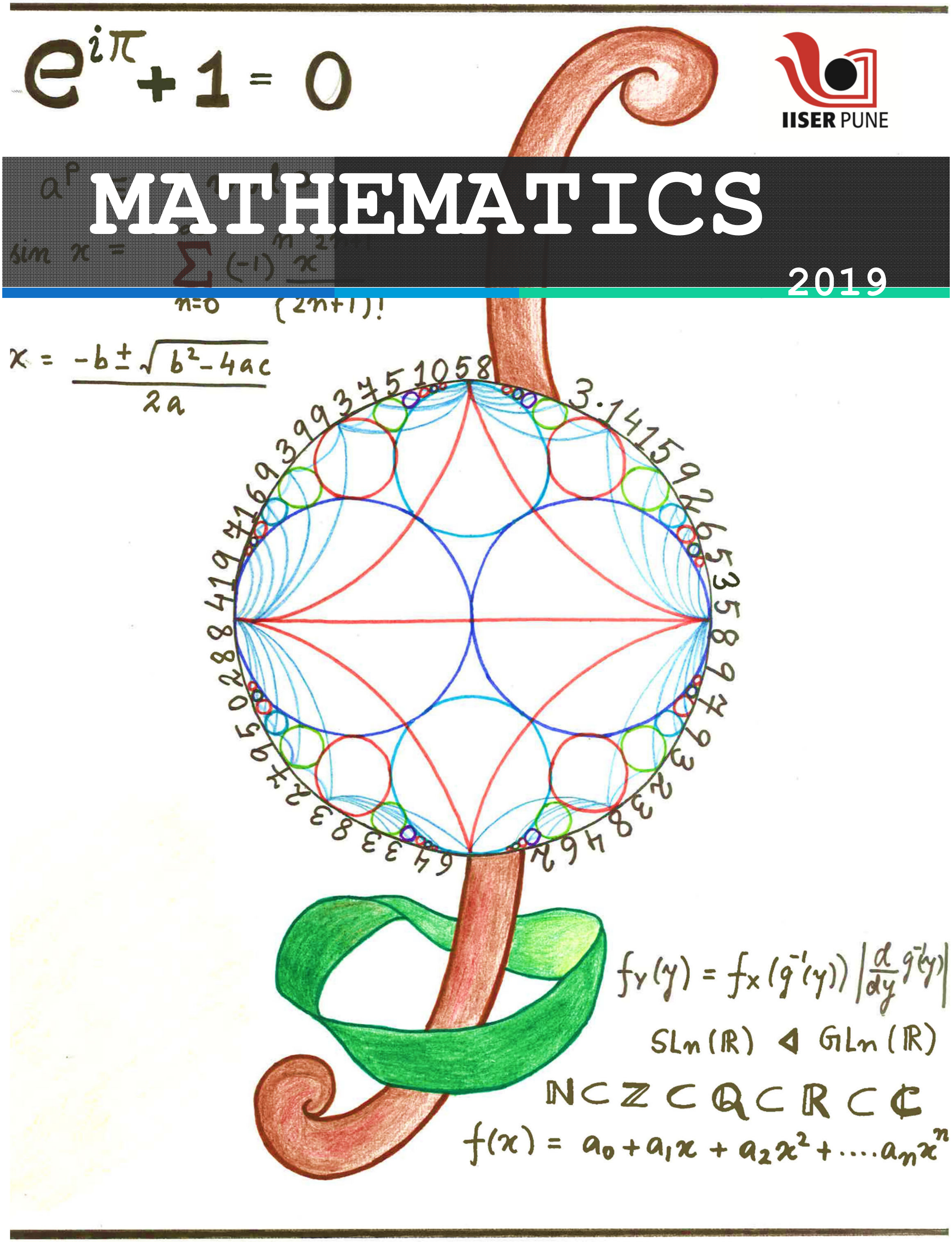
MATHEMATICS

2019

IISER PUNE



MATH MEMBERS

A. Raghuram
Advait Phanse
Amit Hogadi
Amy Binny Philip
Anindya Goswami
Anisa Chorwadwala
Anup Biswas
Anupam Kumar Singh
Ayan Mahalanobis
Ayesha Fatima
Baskar Balasubramanyam
Basudev Pattanayak
Chaitanya Ambi
Chandrasheel Bhagwat
Chitrabhanu Chaudhuri
Debaprasanna Kar
Debargha Banerjee
Debdip Ganguly
Debika Banerjee
Dhruv Bhasin
Diganta Borah
Dilpreet Kaur
Garima Agarwal
Girish Kulkarni
Hitendra Kumar Sahoo
Jewel Mahajan
Jishu Das
Jyotirmoy Ganguly
Kaneenika Sinha
Kartik Roy
Krishna Kaipa
Kuldeep Yadav
Makarand Sarnobat
Manidipa Pal
Manish Mishra
Mitesh Modasiya
Mousomi Bhakta
Namrata Arvind
Narayanan P.
Neeraj Deshmukh
Neha Malik
Pavankumar Dighe
Pranjal Vishwakarma
Prasun Roychowdhury
Pratima
Pritam Bhattacharjee
Rabeya Basu
Rama Mishra
Ramya Nair
Ratna Pal
Ravishankar Yadav
Rijubrata Kundu
Ronit Debnath
Saikat Panja
Shubham Jaiswal
Shuvamkant Tripathi
Soumen Maity
Souptik Chakraborty
Steven Spallone
Sudipa Mondal
Supriya Pisolkar
Surajprakash Yadav
Suvarna Gharat
Taruni S.
Tejas Kalelkar
Tumpa Mahato
Uday Bhaskar Sharma
Uttara Naik-Nimbalkar
Visakh Narayanan
Vivek Mohan Mallick
Yogesh Kolap

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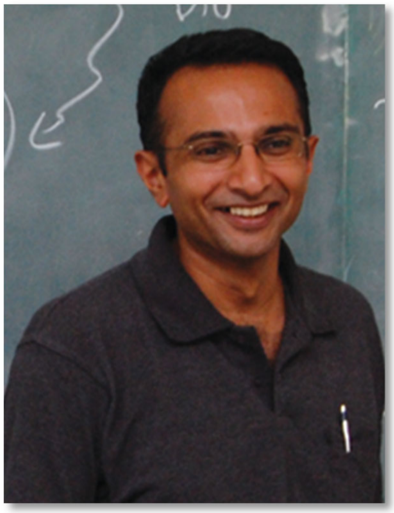
WELCOME MESSAGE BY CHAIR

The mathematics department of IISER Pune brings all areas of pure and applied mathematics, statistics and also theoretical computer science under one umbrella.

The new BSMS curriculum pattern in which students can starting opting for electives starting from the second year (instead of the third) will be implemented starting next year. This will allow the math department to offer more courses and an opportunity to the students to go deeper into a subject of their choice. A lot of work has gone into finalising the course work for this new pattern.

This year we have hosted several workshops and conferences. This includes training programs for Phd students all over the country through the NCM funded AIS/ATM programs, several pedagogical workshops organised in Baskara Lab and last but not the least advanced workshops and conferences in specialised areas (e.g. Knot Theory, Derived Algebraic Geometry, Pune Mumbai Number Theory Seminar, Group Theory, Parametrised Algorithms, etc.). Going forward we would like to find ways in which the number of student seminars and student lead discussion groups can be increased.
Following are some of the recent achievements: Anup Biswas has been appointed as the editor of Annals of applied probability, which is one of the topmost and highly reputed journal in his area. Raghuram's joint research with Harder will appear in Annals of Maths Studies, a math series which is highly competitive and associated
to classics written by great mathematicians like Milnor. Our BSMS students continue to get PhD offers from top places.
I am confident that we as a department will continue to grow in terms of quality of research output as well as quality of outgoing BSMS and PhD students.

AMIT HOGADI
CHAIR, MATHEMATICS, IISER PUNE



A RAGHURAM

Professor
raghuram@iiserpune.ac.in

After getting a BTech in Computer Science and Engineering from Indian Institute of Technology (IIT) Kanpur, Raghuram moved to Mathematics and got a PhD in Mathematics in 2001 from the Tata Institute of Fundamental Research (TIFR), Mumbai, India. He had postdoctoral positions at University of Toronto, Canada and TIFR, Mumbai, India and visiting assistant professorships at Purdue University and University of Iowa, USA. He joined Oklahoma State University, USA in 2006 as a tenure-track assistant professor and was promoted to associate professor with tenure in 2011.Raghuram joined IISER Pune in December 2011 as a Professor and the Coordinator of Mathematics. His research has been partially funded by the National Science Foundation, USA, and the Alexander von Humboldt Foundation, Germany.

NUMBER THEORY, REPRESENTATION THEORY AND AUTOMORPHIC FORMS

My group is currently studying the arithmetic properties of special values of automorphic L-functions.

The earliest prototype of a special value of an L-function is the classical formula by Euler which says that the sum $\sum 1/n^2$ of reciprocals of squares of all positive integers is $\pi^2/6$. More generally, suppose M = $\{a_n\}$ is a sequence of numbers coming from some interesting data, for example, a_p can be the number of solutions of an equation modulo a prime p, then a guiding principle in modern number theory says that to study the sequence M one should study the L-function $L(s, M) = \sum a_n/n^s$. One can glean much information about the sequence M by studying first the analytic properties, and second the arithmetic properties of L(s,M).

The Langlands program, considered by many as a grand unifying principle in modern mathematics, bridges different areas of mathematics, like geometry (elliptic curves), number theory (Galois representations) and representation theory (automorphic forms). The central theme making these bridges possible is the notion of an L-function.

Our work uses the results and techniques of the Langlands program to prove theorems about special values of various L-functions. These values encode within them a lot of arithmetic and geometric information of the objects to which the L-functions are attached. In earlier work stemming from my thesis, we have also studied the representation theory and harmonic analysis of p-adic groups.

SELECTED PUBLICATIONS AND EDITORIAL WORK

Bhagwat, C., and Raghuram, A. Special values for L-functions for orthogonal groups. To appear in *C. R. Math. Acad. Sci. Paris*.

Balasubramanyam, B., and Raghuram, A. Special values of adjoint L-functions and congruences for automorphic forms on GL(n) over a number field. *American Journal of Mathematics* (To appear).

Bhagwat, C., and Raghuram, A. Endoscopy and Cohomology of GL(n). To appear in special volume of the *Bulletin of Iranian Mathematical Society* dedicated to Freydoon Shahidi.

Raghuram, A. (2016). Critical values for Rankin-Selberg L-functions for GL(n) x GL(n-1) and the symmetric cube L-functions for GL (2). *Forum Mathematicum* 28(3):457-489.

Grobner, H. and Raghuram, A. (2014). On the arithmetic of Shalika models and the critical values of L-functions for GL(2n). With an appendix by Wee Teck Gan. *American Journal of Mathematics* 136:675-728.

Bhagwat, C., and Raghuram, A. (2013). Ratios of periods of tensor product motives. *Mathematical Research Letters* 20(4):615-628.

Gan, W.T. and Raghuram, A. (2013). Arithmeticity for periods of automorphic forms. 187-229, Tata Inst. Fund. Res. Stu. Math. No. 22, TIFR, Mumbai.

Harder, G. and Raghuram, A. (2011). Eisenstein cohomology and ratios of critical values of Rankin-Selberg L-functions. *C. R. Acad. Sci. Paris* Ser. I 349:719-724.

AMIT HOGADI

Associate Professor and Chair
amit@iiserpune.ac.in

Amit Hogadi received PhD from Princeton University, USA in 2007. He was at Tata Institute of Fundamental Research (TIFR), Mumbai, India before joining IISER Pune in December 2013.

ALGEBRAIC GEOMETRY

One can describe algebraic geometry as the study of varieties, which are spaces defined by vanishing of polynomial equations. I have been interested in moduli spaces which are special types of varieties which parametrize geometric objects.

In the last couple of decades, people have succeeded in applying ideas from topology, especially homotopy theory, to the study of algebraic varieties. This interplay between homotopy theory and algebraic geometry has been one of my latest fascinations.

Currently, I am working on problems which are sometimes clubbed under the title homotopical algebraic geometry and have applications to K-theory, motivic cohomology and also classical topics like Brauer groups.

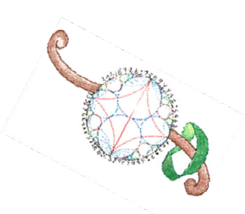
SELECTED PUBLICATIONS

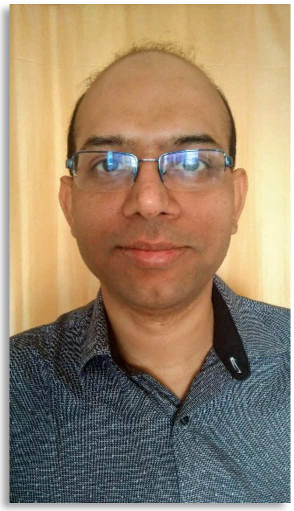
With Indranil Biswas. Fundamental group of quotient singularities. To appear in *International Mathematics Research Notices*.

Esnault, H. and Hogadi, A. (2012). On the algebraic fundamental group of smooth varieties in characteristic p>0. *Transactions of the American Mathematical Society* 364:2429-2442.

Hogadi, A. and Mehta, V. (2011). Birational invariance of the S-fundamental group scheme. *Pure and Applied Mathematical Quarterly* 7(4):1361-1370.

Hogadi, A. and Pisolkar, P. (2011). On the cohomology of Witt vectors of *p*-adic integers and a conjecture of Hesselholt. *Journal of Number Theory* 131(10):1797-1807.





ANINDYA GOSWAMI

Associate Professor
anindya@iiserpune.ac.in

Anindya Goswami received his Bachelor's degree in Mathematics from St. Xavier's College, Calcutta in 2002. He got his PhD from Indian Institute of Science (IISc), Bangalore, India in 2008. Following this, he held postdoctoral positions at the Universiteit Twente in Enschede, The Netherlands; INRIA in Rennes, France; and Technion in Haifa, Israel before joining IISER Pune in 2011. He has received the SPM fellowship as part of the National Award for best performance in National Eligibility Test in Mathematical Sciences. He was reappointed at the same department as an Associate Professor in spring, 2018.

STOCHASTIC CONTROL –

GAME THEORY, MATH FINANCE, QUEUING NETWORKS, RENEWAL PROCESSES

I am exploring various topics in Applied Probability. Those include generalization of Black-Sholes-Merton PDE for options in semi-Markov modulated market, Föllmer Schweizer decomposition of an unattainable contingent claim, equilibrium of non-cooperative semi-Markov game under ergodic cost, optimal control under risk sensitive cost, portfolio optimization, large deviation limit, fluid limit in queuing network, PDE techniques in stochastic control and differential games etc.

I use Markov models, filtering techniques, stochastic calculus, infinitesimal generator for semigroup of operators, mild solution technique for parabolic equations, viscosity solution method for HJB/HJI equations, stability analysis of numerical schemes for solving PDE or IE, convergence of value iteration schemes, marginalization technique in rare event simulation for hybrid processes, martingale formulation for Markov processes etc.

SELECTED PUBLICATIONS

Biswas, A., Goswami, A. and Overbeck, L.(2018). Option Pricing in a Regime Switching Stochastic Volatility Model. Statistics & Probability Letters. 138:116-126.

Das MK., Goswami, A. and Patankar T. (2018). Pricing Derivatives in a Regime Switching Market with Time Inhomogeneous Volatility. Stoch. Anal. Appl. 36(4):700-725.

Das, MK., Goswami, A. and Rana N. (2018). Risk Sensitive Portfolio Optimization in a Jump Diffusion Model with Regimes. SIAM J. Control Optim. 56(2):1550–1576.

Goswami, A., Patel, J. and Sevgaonkar, P. (2016). A system of non-local parabolic PDE and application to option pricing. *Stoch. Anal. Appl.* 34(5):893-905.

Goswami, A. and Nandan, S. (2016). Convergence of estimated option price in a regime switching market. *Indian Journal of Pure and Applied Mathematics* 47(2), 169-182

Goswami, A. and Saini, R.K. (2014). Volterra equation for pricing and hedging in a regime switching market. *Cogent Economics & Finance* 1(2):1-11.

Atar, R., Goswami, A. and Shwartz, A. (2014). On the risk-sensitive cost for a Markovian multiclass queue with priority. *Electronic Communications in Probability* 19(11):1-13.

Atar, R., Goswami, A. and Shwartz, A. (2013). Risk-sensitive control for the parallel server model. *SIAM Journal on Control and Optimization* 51:4363-4386.

ANISA M H CHORWADWALA

Assistant Professor
anisa@iiserpune.ac.in

Anisa Chorwadwala received her PhD from University of Mumbai in 2007. Following this, she held postdoctoral positions at the Institute of Mathematical Sciences (IMSc), Chennai; Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy; and Tata Institute of Fundamental Research (TIFR), Mumbai. She has been on the faculty of IISER Pune since April 2011.

SHAPE OPTIMIZATION PROBLEMS

My research work falls mainly in the following two branches of Mathematics: Partial Differential Equations and Riemannian Geometry. There is a research area involving these two branches of Mathematics called Geometric Analysis. I work on Shape Optimization Problems. A typical shape optimization problem is to find a shape which is optimal in the sense that it minimizes a certain cost functional while satisfying given constraints. In many cases, the functional being minimized depends on the solution of a given partial differential equation defined on a variable domain.

We have solved some shape optimization problems for different classes of doubly connected domains over some Riemannian manifolds. We have considered both the energy minimization and the eigenvalue optimization problems for Dirichlet Boundary Value Problems involving the Laplace Beltrami Operator and also for a nonlinear operator, namely the p-Laplacian for the Euclidean case.

SELECTED PUBLICATIONS

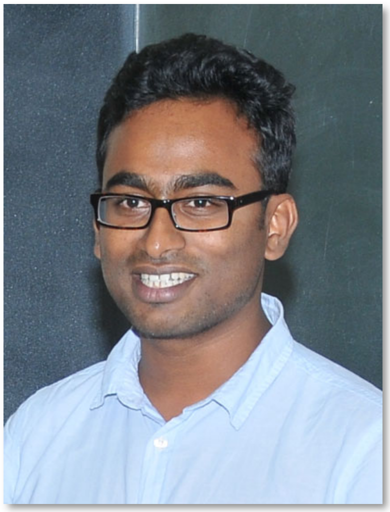
Anisa M. H. Chorwadwala and M. K. Vemuri, "Two functionals connected to the Laplacian in a class of doubly connected domains on rank one symmetric spaces of non-compact type", Geometriae Dedicata, Vol 167, Issue 1, December 2013, pp. 11-21.

Anisa Chorwadwala, Rajesh Mahadevan and Francisco Toledo, "On the Faber-Krahn Inequality for the Dirichlet p-Laplacian", ESAIM: Control, Optimization and Calculus of Variations, Vol 21, Issue 1, 2015, pp. 60-71.

Anisa Chorwadwala and Rajesh Mahadevan, "An eigenvalue optimisation problem for the p-Laplacian", Proceedings of the Royal Society of Edinburgh: Section A Mathematics, Vol 145, Issue 6, 2015, pp. 1145-1151.

Anisa M H Chorwadwala, "A glimpse of Shape Optimization Problems", CURRENT SCIENCE, VOL. 112, NO. 7, 10 APRIL 2017.

Anisa M. H. Chorwadwala and Souvik Roy, "How to Place an Obstacle Having a Dihedral Symmetry Inside a Disk so as to Optimize the Fundamental Dirichlet Eigenvalue", Journal of Optimization Theory and Applications, Springer Nature, 2019.



ANUP BISWAS

Associate Professor and Co-Chair
anup@iiserpune.ac.in

Anup Biswas received his PhD from TIFR-Centre for Applicable Mathematics, Bangalore, India in 2011. He held postdoctoral positions at Technion, Israel, and University of Texas, Austin, USA before joining IISER Pune.

STOCHASTIC CONTROLS AND QUEUEING THEORY

My broad research area falls under Applied Probability. I am mainly interested in stochastic controls, small noise diffusion, asymptotics of queueing networks and many other related models.

In the last couple of years, I have worked on problems from queueing theory that involves measure-valued process. Such processes have proven powerful in modeling queueing networks with general service and reneging distributions. Another important area of queueing theory is scheduling control where one looks for a policy that optimizes certain cost associated to the model. I also work on such control problems.

SELECTED PUBLICATIONS

Biswas, A., Hitoshi, I., Subhamay, S. and Lin, W. (2017). On viscosity solution of HJB equations with state constraints and reflection control. *SIAM J. of Control and Optimization* 55(1):365-396.

Arapostathis, A., Biswas, A. and Johnson, C. (2017). On solutions of mean field games with ergodic cost. *Journal de Mathematiques Pures et Appliquees* 107:205-251.

Arapostathis, A., Biswas, A. and Luis, C. (2016). The Dirichlet problem for stable-like operatorsand related probabilistic representations. *Communications in PDE* 41(9):1472-1511.

Arapostathis, A., Biswas, A. and Pang, G. (2015). Ergodic control of multi-class M/M/N+M queues in the Halfin-Whitt regime. *Annals of Applied Probability* 25(6):3511-3570.

Atar, R., Biswas, A. and Kaspi, H. (2015). Fluid limits of G/G/ 1+G queues under non-preemptive Earliest-Deadline-First discipline. *Mathematics of Operation Research* 40(3):683-702.

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ANUPAM KUMAR SINGH

Associate Professor

anupam@iiserpune.ac.in

After doing MSc (Mathematics) from Indian Institute of Technology (IIT) Kanpur, Anupam Singh worked for his doctorate at Harish Chandra Research Institute, Allahabad and Indian Statistical Institute (ISI), Bangalore, India and got PhD from ISI in 2007. He held postdoctoral positions at Tata Institute of Fundamental Research (TIFR), Mumbai and Institute of Mathematical Sciences (IMSc), Chennai, India before joining the faculty of IISER Pune in 2008.

CONJUGACY QUESTIONS AND REPRESENTATION THEORY OF GROUPS

Conjugacy questions in group theory have been of interest for its connection with the representation theory and they have not been understood very well for Algebraic Groups over arbitrary field. Usually groups are difficult objects and one studies them via their representations to get a better understanding.

Let G (e.g. GL_n) be an algebraic group defined over a field k. We denote the k points of G by $G(k)$ (e.g. $GL_n(k)$, $SL_n(k)$ etc.). An element t of $G(k)$ is said to be real if it is conjugate to its own inverse in $G(k)$. I have been concerned with finding real elements in algebraic groups. Very interestingly often it relates to finding strongly real elements (the elements which are product of two involutions in $G(k)$).

Apart from studying structure of real elements in Algebraic Groups over k, I also looked at many examples such as linear groups, orthogonal groups, symplectic groups and the groups of type G_2 to get better understanding of the problem. Finding real elements helps in the understanding of real characters of the group which in turn give information about those complex representations of the group which are either orthogonal or symplectic.

SELECTED PUBLICATIONS

Gates, Z., Singh, A. and Ryan Vinroot, C. Strongly real classes in finite Unitary groups of odd characteristic. To appear in the *Journal of Group Theory*.

Kulshrestha, A. and Singh, A. (2011). Real elements and Schur indices of a group. *The Mathematics Student* 80:73-84.

Gill, N. and Singh, A. (2011). Real and strongly real classes in $PGL_n(q)$ and quasi-simple covers of $PSL_n(q)$. *Journal of Group Theory* 14:461-489.

Gill, N. and Singh, A. (2011). Real and strongly real classes in $SL_n(q)$. *Journal of Group Theory* 14:437-459.

AYAN MAHALANOBIS

Assistant Professor

ayanm@iiserpune.ac.in

Ayan Mahalanobis obtained his PhD from Florida Atlantic University, Boca Raton, USA in 2005. He was a Visiting Assistant Professor at the Stevens Institute of Technology, New Jersey, USA for a few years before joining IISER Pune in 2009.

PUBLIC KEY CRYPTOGRAPHY

I work at the intersection of pure mathematics (group theory) and public key cryptography. Cryptography, especially public key cryptography, is the backbone of a modern society. It serves us with the required tools for online transactions and trading, *i.e.*, online commerce.

My research aims to find new cryptograhic primitives and to build secure protocols from that. We look for groups in which the discrete logarithm problem is secure. My recent work has shown that the group of non-singular circulant matrices over a finite field has some properties that make them attractive over the discrete logarithm problem on a finite field. This new finding has opened a new avenue in research of public key cryptography.

SELECTED PUBLICATIONS

Mahalanobis, A. The ElGamal cryptosystem over circulant matrices (Submitted).

Mahalanobis, A. and Shah, J. (2014). A new guess-and-determine attack on the A5/1 stream cipher. *Computer and Information Science* 7(1):115-124.

Mahalanobis, A. (2013). Are matrices useful in public-key cryptography? *International Mathematical Forum* 8(39):1939-1953.

Mahalanobis, A. The MOR cryptosystem and extra-special *p*-groups. Proceedings of WCC 2012, Castro Urdiales, Spain July 9-13, 2012 & To appear in *Journal of Discrete Mathematics and Cryptography*.

Mahalanobis, A. (2013). The automorphism group of the group of unitriangular matrices over a field. *International Journal of Algebra* 7(15):723-733.

Mahalanobis, A. (2012). A simple generalization of the ElGamal cryptosystem to non-abelian groups II. *Communications in Algebra* 40:3583-3596.

Mahalanobis, A. (2010). The discrete logarithm problem in the group of non-singular circulant matrices. *Groups Complexity Cryptology* 2:83-89.

BASKAR BALASUBRAMANYAM

Assistant Professor
baskar@iiserpune.ac.in

Baskar Balasubramanyam completed his PhD from Brandeis University, USA in 2007. In 2007-08, he was a postdoctoral fellow at the Center for Advanced Study in Mathematics at the Ben-Gurion University of the Negev in Israel. Following this, he was a Bateman Instructor at California Institute of Technology, USA during 2008-10. He has been with IISER Pune since September 2010.

MODULAR FORMS AND GALOIS REPRESENTATIONS

My research interests are in Number Theory. A modular form is essentially a function defined on the complex upper half-plane (everything above the real axis) that behaves in a good way under transformations of certain 2x2 matrices with integer entries. The expansion at infinity of such a function gives us a power series whose coefficients have interesting arithmetic properties. An important example of numbers that arise in such a way is the Ramanujan Tau function $\tau(n)$. In order to understand these coefficients, it is useful to consider an object attached to it called the *L*-function (these are generalizations of the Riemann zeta function).

A Galois group is a set of permutations of roots of an irreducible polynomial. For example, complex conjugation permutes the roots of x^2+1. It is possible to represent such permutations by matrices. One of the problems in Number Theory is to try and understand the Galois group by studying its representations. One can also attach *L*-functions to Galois representations and in some cases modular forms and Galois representations are related through their *L*-functions.

SELECTED PUBLICATIONS

Balasubramanyam, B. and Raghuram, A. Special values of adjoint *L*-functions and congruences for automorphic forms on *GL*(*n*) over a number field *American Journal of Mathematics* (To appear).

Balasubramanyam, B., Ghate, E. and Vatsal, V. (2013). On local Galois representations over totally real fields. *Manuscripta Mathematica* 142:513-524.

Balasubramanyam, B. and Longo, M. (2010). Λ-adic modular symbols over totally real fields. *Commenterii Mathematici Helvetici* 86:841-865.

CHANDRASHEEL BHAGWAT

Assistant Professor

cbhagwat@iiserpune.ac.in

Chandrasheel Bhagwat completed his PhD in Mathematics from Tata Institute of Fundamental Research (TIFR) Mumbai, India in 2011 and spent a few months as a post-doctoral fellow at IISER Pune. He has received the DST-INSPIRE faculty award and research grant in 2011 and has joined IISER Pune as INSPIRE Faculty in March 2012. From December 1, 2014, he has been working as an Assistant Professor at IISER Pune.

REPRESENTATION THEORY, ANALYSIS & GEOMETRY OF LOCALLY SYMMETRIC SPACES, NUMBER THEORY

From last few years, I have been studying the arithmetic aspects of the spectral theory and geometry of symmetric spaces. My thesis work involved proving various analogues of the classical number theoretic results in the context of symmetric spaces. In a recent joint work with my colleague Dr. Supriya Pisolkar from Mathematics group at IISER Pune, we have proved some results on representation equivalence of discrete subgroups in Lie groups. I am also interested in the study of analytic properties of the Zeta functions associated to a rank one locally symmetric space. My students and me are working on some of the `inverse problems' on locally symmetric spaces with the aid of Zeta functions and harmonic analysis.

Another area in mathematics that fascinates me is special values of L-functions. My earlier joint work with Prof. Raghuram has established period relations for the tensor product of motives. I am currently working on some related problems about special values for automorphic *L*-functions associated to representations of algebraic groups (GL(n), SO(n) etc.); using techniques like Cohomology of arithmetic groups and Langlands constant term theory.

Recently, I have been involved in studying some questions in spectral graph theory and their relation with arithmetic, analysis and geometry. I have worked with two of my colleagues Prof. G. Ambika and Mr. Snehal Shekatkar (from Physics group at IISER Pune) on a project where we established some interesting results for natural number network, viewed as a complex network. In another ongoing project with my colleagues Dr. Anisa MHC and Mr. Pralhad Shinde (from Mathematics group at IISER Pune), we are working on some theorems about graph Laplacians which will be analogues of certain optimization theorems in classical geometry.

SELECTED PUBLICATIONS

Bhagwat C. and Raghuram A. (2017). Special values of *L*-functions for orthogonal groups. *Comptes rendus - Mathematics*. (To appear).

Shekatkar, S.M., Bhagwat, C. and Ambika, G. (2015). Divisibility patterns of natural numbers on a complex network. *Scientific Reports* 5, Article number: 14280 (2015), doi:10.1038/srep14280

Bhagwat, C. (2015). On Deligne periods for tensor product motives. *Comptes rendus - Mathématique* 353:191- 195.

Bhagwat, C. and Pisolkar, S. (2015). On uniform lattices in real semisimple group. *Proceedings of the American Mathematical Society* doi: 10.1090/proc/12961

Bhagwat, C. and Raghuram, A. Endoscopy and Cohomology of GL(N). (Accepted for publication in the special issue of the BIMS in honor of Professor Freydoon Shahidi's 70th birthday.)

CHITRABHANU CHAUDHURI

INSPIRE Faculty
chitrabhanu@iiserpune.ac.in

Chitrabhanu did his PhD in Mathematics from Northwestern University 2007-2013 and was a postdoctoral fellow at Max Plank Institute for Mathematics (2013-2014) before joining IISER Pune.

TOPOLOGY AND GEOMETRY OF THE MODULI OF CURVES

The Moduli of Curves parametrizes algebraic curves or Riemann surfaces up to isomorphism. It has been a central topic in mathematical research for several decades and brings various fields of mathematics together, for example Algebraic Geometry, Geometric Group theory and Enumerative geometry. It has important connections with physics as well.

Recently in collaboration with Debargha Banerjee and Diganta Borah we studied aspects of Arakelov geometry of certain moduli spaces of elliptic curves. This work has applications in Number theory, specifically the theory of Modular forms.

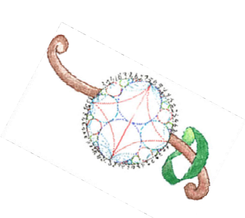
SELECTED PUBLICATIONS

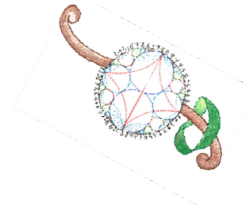
Stable arithmetic self-intersection of Modular Curves X_0(p^2); with Debargha Banerjee, submitted.

Self intersection of relative dualizing sheaf for minimal regular model of modular curve X_0(p^2); with Debargha Banerjee and Diganta Borah, Submitted.

Equivariant cohomology of certain moduli of weighted pointed rational curves; Manuscripta Math. 150 (2016), no. 1-2, 137-150.

The Cohomological Excess of Certain Moduli Spaces of Curves of Genus g; IMRN 2015, no. 4, 1056-1074.





DEBARGHA BANERJEE

Assistant Professor

debargha@iiserpune.ac.in

Debargha Banerjee received his PhD degree from Tata Institute of Fundamental Research, Mumbai. He earned his Master's degree in Mathematics from Indian Statistical Institute and BSc from St Xavier's College, Kolkata. He got the Australian Research council Discovery postdoctoral fellowship for 2 years at the Australian National University, Canberra, Australia. He was a visiting scientist at the IMSC, Chennai, India and later a guest scientist at the Max Planck institute of Mathematics, Bonn, Germany before joining IISER Pune in November 2013.

AUTOMORPHIC FORMS AND ARITHMETIC GEOMETRY

In arithmetic geometry, we study the integral solutions of polynomial equations. In arithmetic geometry we usually work over non-algebraically closed fields (like rational numbers), and often in fields of non-zero characteristic (like finite fields), and we may even restrict ourselves even to rings that are not a field (like integers). We use the rich theory of modular forms (more generally, automorphic representations) to find these solutions.

Modular forms/ automorphic forms are generalizations of the periodic functions like sine or cosine. The theory of modular forms made major contributions in several important discoveries in modern mathematics, including the uniform boundedness of torsion point of elliptic curves.

I am interested in understanding objects in geometry called "motives" and objects in analysis called automorphic representations. The overarching bridge/conjecture of Langlands connects these two fairly faraway worlds. I am interested in understanding the integral and p-adic bridges that connect these two beautiful universes.

In the automorphic universe, I wish to focus on modular symbols and special values of L-functions (one of the main objects of study in the Langlands' program). Motives can be described by different cohomology theories. I wish to understand and use different cohomology theories using modular symbols, which in turn give insights into special values of L-functions.

In another work, I developed the theory of differential modular forms for Shimura curves over totally real fields. The differential modular forms were invented by Buium and his collaborators. These works open the p-adic bridge of certain automorpic forms.

SELECTED PUBLICATIONS

Banerjee, D. Merel, L., The Eisenstein cycles as modular symbols, the Journal of the London Mathematical Society, no. 2, 2018, 329-348

Banerjee, D., Mandal, T. Supercuspidal ramifications and traces of adjoint lifts at good primes (to appear in the Journal of number theory, 2019)

Banerjee, D., Borah, D. and Chaudhuri, C. Arakelov Self intersection numbers of minimal regular models of modular curves $X_0(p^2)$ over the rational numbers (submitted).

Banerjee, D. and Chaudhuri, C. Arithmetic applications of self-Intersection numbers for Modular Curves $X_0(p^2)$ (submitted).

Banerjee, D.; Krishnamoorthy, S. (2016). The Eisenstein elements for level product of two odd primes. *Pacific Journal of Mathematics,* Vol. 281 (2).

Banerjee, D. (2014). A note on the Eisenstein elements of prime square level. *Proceedings of the American Mathematical Society* 142:3675-3686.

Banerjee, D. (2014). Differential modular forms on Shimura curves over totally real fields. *Journal of Number Theory* 135:353-373.

Banerjee, D. and Ghate, E. (2013). Adjoint lifts and modular endomorphism algebras. *Israel Journal of Mathematics* 195(2):507-543.

DEBDIP GANGULY

Assistant Professor
debdip@iiserpune.ac.in

Debdip Ganguly received his Masters and his PhD degree from Tata Institute of Fundamental Research, Centre for Applicable Mathematics (TIFR-CAM), India, 2010-2014. He held postdoctoral positions at Politecnico Di Torino, Department of Mathematical Sciences, Turin, Italy, October 2014 - November 2015 and Technion, Israel Institute of Technology, Department of Mathematics, Haifa, Israel, December 2015 - November 2017, before joining IISER Pune as an Assistant Professor in December 217.

PARTIAL DIFFERENTIAL EQUATIONS OF ELLIPTIC AND PARABOLIC TYPE, NON-LINEAR ANALYSIS ON MANIFOLDS

Broadly speaking my research focuses on partial differential equations of Elliptic and Parabolic type and non linear analysis on manifolds. To be more precise:

As a Graduate student I started working on nonlinear elliptic partial differential equations and variational methods. Several problems arising in differential geometry, physics and other topics give rise to semi-linear variational elliptic equations. Particularly my aim is to study these equations on the hyperbolic space. It includes the study of existence, non existence and the qualitative properties like symmetry, compactness, non degeneracy and stability of solutions for the non compact variational problems.

With time my interests have branched towards functional and geometric inequalities, spectral theory and heat kernel estimates. It includes the study of inequalities with sharp constants, criticality theory for elliptic second order partial differential operator and Liouville Theorem for Schrödinger operator. Another aspect of my research is to study equivalence of heat kernels on Riemannian manifolds for the second order parabolic operator.

SELECTED PUBLICATIONS

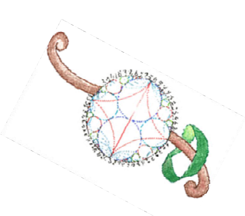
Ganguly,D ; Pinchover,Y ; On Green functions of second-order elliptic operators on Riemannian manifolds: The critical case,(*to appear in Journal of Functional Analysis*),2018.

Berchio,E ; Ganguly,D ; Grillo,G ; Sharp Poincaré-Hardy and Poincaré-Rellich inequalities on the hyperbolic space. *J. Funct. Anal.* 272 (2017), no. 4, 1661–1703.

Berchio,E ; Ganguly,D ; Improved higher order Poincaré inequalities on the hyperbolic space via Hardy-type remainder terms. *Commun. Pure Appl. Anal.* 15 (2016), no. 5, 1871–1892.

Ganguly,D ; Kunnath,S ; Sign changing solutions of the Brezis-Nirenberg problem in the hyperbolic space. *Calc. Var. Partial Differential Equations* 50 (2014), no. 1-2, 69–91.

Ganguly,D ; Sign changing solutions of the Hardy-Sobolev-Maz'ya equation. *Adv. Nonlinear Anal.* 3 (2014), no. 3, 187–196



DIGANTA BORAH

Assistant Professor
dborah@iiserpune.ac.in

Diganta Borah received his PhD from the Indian Institute of Science (IISc), Bangalore, India in 2010 and was a Research Associate there until 2011. He joined IISER Pune in January 2012.

SEVERAL COMPLEX VARIABLES

My research interests are in complex analysis, more specifically in several complex variables. Several complex variables is the study of holomorphic functions defined on domains in $\mathbb{C}^n$, or more generally on complex manifolds. The subject established itself as a new independent area of research in the early twentieth century when F. Hartogs discovered a surprising extension phenomenon in the theory of functions of several complex variables which is absent in the theory in one variable. In the complex plane, every domain is a domain of holomorphy, i.e., there exists a holomorphic function on the domain which has no holomorphic extension to a strictly larger domain. Hartogs showed that this is no longer true in higher dimension. Another astonishing feature of several complex variables is the absence of the Riemann mapping theorem which was discovered by Poincare around the same time by showing that the unit ball and the unit polydisc in $\mathbb{C}^n$, $n \geq 2$, are not biholomorphic though both of them are simply connected.

In the past, I investigated several questions related to the Robin metric on bounded pseudoconvex domains in $\mathbb{C}^n$, capacity metric on planar domains, and the multidimensional Suita conjecture. Some of my current projects are to understand a class of weighted Bergman metrics, the volume elements of Carathéodory and Kobayashi-Eisenman, and various aspects of the squeezing function and its dual Fridman invariant.

SELECTED PUBLICATIONS

(With G.P. Balakumar, P. Mahajan and K. Verma) Remarks on the higher dimensional Suita conjecture, accepted for publication in the Proceedings of the AMS.

(With P. Haridas and K. Verm-a) Comments on the Green's function of a planar domain, Anal. Math. Phys. 8 (2018), 383–414.

Remarks on the metric induced by the Robin function II, Michigan Math. J. 62 (2013), 581–630.

(With K. Verma) Remarks on the metric induced by the Robin function, Indiana Univ. Math. J. 60 (2011), no. 3, 751–802.

KANEENIKA SINHA

Assistant Professor
kaneenika@iiserpune.ac.in

Kaneenika Sinha completed her PhD from Queen's University, Canada in 2006. She has held postdoctoral fellowships at University of Toronto, University of Alberta and Mathematical Sciences Research Institute, Berkeley. She was an assistant professor in IISER Kolkata before joining IISER Pune in December 2012.

ANALYTIC NUMBER THEORY, HARMONIC ANALYSIS AND ARITHMETIC GEOMETRY

My primary research interests are in analytic number theory and arithmetic geometry. One of my primary goals is to investigate statistical phenomena in the distribution of sequences that arise from the theory of modular forms, zeta functions of curves over finite fields and eigenvalues of adjacency matrices of certain kinds of graphs.

In 1916, the German mathematician Hermann Weyl asked the following question: take an irrational number T, look at its multiples T, 2T, 3T, etc. and record the sequence of its decimal parts. While these numbers find a place throughout the interval [0,1), are they likely to cluster around some parts more than others? Weyl discovered that each and every part of the interval [0,1) gets its fair share of elements from the sequence. That is, this sequence is equidistributed in the interval [0,1). In showing this, Weyl discovered and outlined a beautiful technique that was capable of answering generalizations of this question in a wider paradigm. This technique relates the phenomenon of equidistribution to that of studying what are called exponential sums in number theory and places this phenomenon in a wider landscape of harmonic analysis.

Many sequences arising in number theory follow a distribution pattern that can be defined by very elegant functions. In particular, one of the major breakthroughs in recent times is the discovery that certain sequences arising from the Fourier coefficients of modular forms (certain complex-analytic functions with rich inner symmetries and growth conditions) follow the "semi-circle" equidistribution law, also called the Sato-Tate law.
My primary research work focuses on equidistribution of various such families and sequences arising in the context of modular forms, arithmetic geometry and graph theory. I am investigating deeper statistical phenomena associated with such families, for example fluctuations in the distribution and pair correlation.

SELECTED PUBLICATIONS

B. Baskar and K. Sinha (2019), Pair correlation statistics for Sato-Tate sequences, accepted for publication in Journal of Number Theory.

N. Prabhu and K. Sinha (2017) Fluctuations in the distribution of Hecke eigenvalues about the Sato-Tate measure, with Neha Prabhu, accepted for publication in International Mathematics Research Notices.

Ram Murty, M. and Sinha, K. (2015). The generalized Dedekind determinant, in SCHOLAR---a Scientific Celebration Highlighting Open Lines of Arithmetic Research, Contemporary Mathematics, 655:153-164.

Bucur, A., David, C., Feigon, B., Lalin, M. and Sinha, K. (2012). Distribution of zeta zeroes of Artin-Schreier covers. *Mathematical Research Letters* 19(6):1329-1356.

KRISHNA KAIPA

Assistant Professor
kaipa@iiserpune.ac.in

Krishna Kaipa obtained a BTech from IIT Bombay and an MS degree from University of Maryland College Park, both in Mechanical Engineering. He then pursued a PhD in Mathematics from University of Maryland, College Park. He held assistant professor positions at IIT Bombay and IISER Bhopal before moving to IISER Pune in 2014.

CODING THEORY AND COMBINATORICS

My research in recent years focuses on some fundamental open problems in the theory of Error Correcting Codes (Coding Theory). One such problem is the resolution of the MDS conjecture in finite algebraic geometry. Another problem is to establish the analytical properties like convexity and differentiability for the asymptotic information rate function for codes, as well as to improve on the best known upper and lower bounds for this function.

To motivate the MDS conjecture, consider k by n matrices over a finite field with q elements (say q is odd) such that all k by k minors of this matrix are nonzero. let us call such a matrix MDS.

Question: What can we say about 3 by q+1 MDS matrices?
Beniamino Segre showed that any such matrix is row equivalent to a matrix whose columns lie on the conic y^2 = xz.

Question: Do there exist k by q+2 MDS matrices when k <q?
The negative answer to this question is the MDS conjecture.

SELECTED PUBLICATIONS

An improvement of the asymptotic Elias bound for non-binary codes , IEEE Transactions on Information Theory, vol. 64, Issue 7, 2018.

Deep holes and MDS extensions of Reed-Solomon codes, IEEE Transactions on Information Theory, Vol. 63, Issue 8, 2017.

With P. Beelen, T. Hoholdt and D. Glynn. Counting Generalized Reed-Solomon codes. Advances in the Mathematics of Communication, Volume 11, Issue 4, 2017

With I. Cardinali, L. Giuzzi, and A. Pasini (2016). Line polar Grassmann codes of orthogonal type. Journal of Pure and Applied Algebra, 220(5):1924-1934.

An asymptotic formula in q for the number of [n, k] q-ary MDS codes. IEEE Transactions on Information Theory 60 (2014), no. 11, 7047–7057.

MAINAK PODDAR

Professor
mainak@iiserpune.ac.in

Mainak Poddar obtained his PhD in 2001 from the University of Wisconsin-Madison. He held postdoctoral positions at Michigan State University and the University of Waterloo. Before joining IISER Pune, he has been a faculty member at the Indian Statistical Institute Kolkata, the Los Andes University in Bogota and the Northern Cyprus Campus of the Middle East Technical University.

GEOMETRY AND TOPOLOGY

I work mainly at the interface of complex algebraic geometry, symplectic geometry and differential topology. A significant part of my work is devoted to the impact of symmetries on geometric invariants. Often these invariants are of quantum type like Floer homology or Chen-Ruan cohomology. My recent work focuses on (equivariant) vector and principal bundles. I have also become very interested in generalized complex geometry.

SELECTED PUBLICATIONS

Poddar, M. and Thakur, A. S. (2018). Group actions, non-Kahler complex manifolds and SKT structures. Complex Manifolds 5, 9-25.

Biswas, I., Dey, A. and Poddar, M. (2018). On equivariant Serre problem for principal bundles. Internat. J. Math. 29, no. 9, 1850054, 7 pp.

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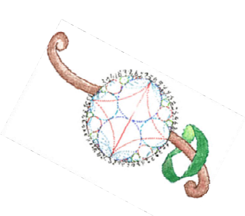

MANISH MISHRA

Assistant Professor

manish@iiserpune.ac.in

Manish Mishra did his B.Tech. in Materials & Metallurgical Engineering from Indian Institute of Technology (IIT) Kanpur. He then moved to mathematics. He got his Ph.D. in mathematics in 2013 from Purdue University, USA. He then held postdoctoral positions at the Hebrew University of Jerusalem, Isreal and the Heidelberg University, Germany. He joined IISER Pune in August 2016.

LOCAL LANGLANDS PROGRAM, REPRESENTATION THEORY OF REDUCTIVE GROUPS OVER LOCAL FIELDS

One way of defining number theory is that it is the study of the existence of rational solutions of polynomials equations defined over integers. This amounts to studying the absolute Galois group Γ of the field of rational numbers. The group Γ is very large and is difficult even to write down particular elements of it. One studies it by studying its action on linear spaces, i.e., by studying its space of representations. The Langlands program is a scheme of organizing this vast information. It relates Galois representations with certain, more concretely defined, analytic objects called automorphic representations from which arithmetic information can be extracted. Important applications of the Langlands program to some of the famous problems in number theory include the Artin's conjecture on L-functions, Fermat's Last Theorem, the Sato-Tate conjecture, and the behavior of Hasse-Weil zeta functions.

The conjectures within the Langlands program are quite precise and technical. My current research is about the local Langlands program. The projects I am working on are about/related to – study of Hecke algebras associated to Bernstein blocks and the centers of these blocks, describing Langlands-Shelstad transfer via Hecke algebra morphisms, ABPS conjecture and the stable Bernstein center conjecture.

SELECTED PUBLICATIONS

(with Jeffrey Adler) Self-dual cuspidal representations.

(with Basudev Pattanayak) A note on depth preservation, Journal of the Ramanujan Mathematical Society, to appear.

(with Bertrand Lemaire) Matching of orbital integrals (geometric transfer) and Roche Hecke algebra isomorphisms, arXiv:1711.01098,(2017)

Signs of self-dual representations, arXiv:1610.04149, (2016)

Bernstein center of supercuspidal blocks, Journal für die reine und angewandte Mathematik (Crelle's Journal), (2016), DOI: 10.1515/crelle-2016-0041.

(with Mirko Rösner) Genericity under parahoric restriction, Manuscripta Mathematica, 152 (2017), no. 1-2, 241-245

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A Galois side analogue of a theorem of Bernstein, Journal of the Ramanujan Mathematical Society, 30, No. 4 (2015) 397-402.

Generic representations in L-Packets, International Journal of Number Theory, Vol. 12, No. 6 (2016) 1613–1624.

MOUSOMI BHAKTA

Assistant Professor
mousomi@iiserpune.ac.in

Mousomi Bhakta received her PhD from TIFR-Centre for Applicable Mathematics, Bangalore, India in August, 2011. After that she held visiting scientist position in ICTP, Trieste, Italy for two months. Next, she had postdoctoral positions at Technion, Israel for two years and University of New England, NSW, Australia for one year before joining IISER Pune in August 2014.

ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS

My research interest includes local and nonlocal type semilinear and quasilinear elliptic partial differential equations and system of equations arising from geometry and physics. I study existence/nonexistence of positive/sign-changing solutions, qualitative properties of solutions, various estimates of solutions and asymptotic analysis of the profile of solutions using the techniques from nonlinear analysis. Another important area of my research is studying elliptic equations (local and nonlocal type) with measure data and generalized boundary trace.

SELECTED PUBLICATIONS

Bhakta, M.; Nguyen, P. T., Boundary value problems with measures for fractional elliptic equations involving source nonlinearities, (submitted) arXiv:1801.01544

Bhakta, M.; Nguyen, P. T., On the existence and multiplicity of solutions to fractional Lane-Emden elliptic systems involving measures, (submitted) arXiv:1809.07909

Bhakta, M.; Mukherjee, D., Nonlocal scalar field equations: qualitative properties, asymptotic profiles and local uniqueness of solutions, to appear in J. Differential Equations. (2019).

Bhakta, M.; Mukherjee, D., Multiplicity results for (p, q) fractional Laplace equations involving critical nonlinearities, Adv. Differential Equations Volume 24, Numbers 3-4 (2019), 185-228.

Bhakta, M.; Mukherjee, D. and S. Santra, Profile of solutions for nonlocal equations with critical and supercritical nonlinearities Commun. Contemp. Math. Vol. 21, No. 1 (2019).

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Bhakta, M; Mukherjee, D., Multiplicity results and sign changing solutions of non-local equations with concave-convex nonlinearities. Differential Integral Equations 30 (2017), no. 5-6, 387–422.

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Bhakta, M.; Marcus, M., Reduced limit for semilinear boundary value problems with measure data. J. Differential Equations 256 (2014), no. 8, 2691–2710.

Bhakta, M.; Musina, R., Entire solutions for a class of variational problems involving the biharmonic operator and Rellich potentials. Nonlinear Anal. 75 (2012), no. 9, 3836–3848.

Bhakta, Mousomi; Sandeep, K. Poincaré-Sobolev equations in the hyperbolic space. Calc. Var. Partial Differential Equations 44 (2012) No. 1-2, 247–269.

Bhakta, M.; Sandeep, K. Hardy-Sobolev-Maz'ya type equations in bounded domains. J. Differential Equations 247 (2009), no. 1, 119–139

RABEYA BASU

Assistant Professor

rbasu@iiserpune.ac.in

Rabeya Basu received her PhD from Tata Institute of Fundamental Research (TIFR), Mumbai, India in 2007. She then undertook postdoctoral work initially at Harish Chandra Research Institute, Allahabad and later as an NBHM Fellow at the Indian Statistical Institute, Kolkata, India. She was in IISER Kolkata as an assistant professor before joining IISER Pune in 2010.

CLASSICAL ALGEBRAIC K-THEORY

My work is based on problems in classical K-theory which are related to Serre's problem on projective modules. This famous theorem says that finitely generated projective modules over a polynomial ring over field are free. This involves problems in lower K-theory, in particular study of the Whitehead group $K1$ due to Hyman Bass, which generalizes the group of units of a ring. Initially, these problems were studied for the general linear groups. Then people started generalizing those results for other classical groups and also for the relative cases. At present, I am working on similar problems for the general quadratic and the general Hermitian groups introduced by Anthony Bak. In addition, I am also trying to study few such problems for the higher K-groups.

Recently, I have developed my interest in a very newly developed subject, viz. Leavitt path algebras (LPA), which is making a bridge between algebra and functional analysis. In the future, I would like to work on the algebraic and K-theoretic aspects of LPA.

SELECTED PUBLICATIONS

R. Basu; Local-Global Principle for the General Quadratic and the General Hermitian Groups and the Nilpotence of KH_1. Zap. Nauchn. Sem. S.-Peterburg. Otdel. Mat. Inst. Steklov. (POMI) 452 (2016), Voprosy Teorii Predstavleniĭ Algebr i Grupp. 30, 5--31; English Translation in J. Math. Sci. (N.Y.) 232 (2018), no. 5, 591–609.

R. Basu; On Transvection Subgroups of General Quadratic Modules. Journal of Algebra and Its Application. Vol. 17, No. 11, 1850217 (2018).

R. Basu, Ravi A. Rao, Reema Khanna; Pillars of relative Quillen--Suslin Theory. (Partially accepted for the book "Leavitt Path Algebras and K-theory", ISI Series, Springer)

R. Basu, Manish Kumar Singh; On Quillen--Suslin Theory for Classical Groups; Revisited over Graded Rings. (Accepted in Contemporary Math. Volume in honor of Professor S.K. Jain.)

RAMA MISHRA

Associate Professor
r.mishra@iiserpune.ac.in

Rama Mishra has obtained her PhD from Indian Institute of Technology (IIT) Bombay, India in 1994. She spent a few years with Harish Chandra Research Institute, Allahabad and Indian Statistical Institute, Delhi as a postdoctoral fellow and then served as a faculty at IIT Kharagpur and IIT Delhi for several years. She worked as a JSPS fellow at Osaka City University, Japan for one year and as a visiting faculty at Boise State University, USA before joining IISER Pune.

LOW DIMENSIONAL TOPOLOGY

Quantum topology is one of the emerging research areas. Many knot invariants naturally arise through nice matrix algebra representation of interesting quantum groups. They have been related to several models in statistical mechanics. I would like to explore some models that are related to Singular knot theory.

I am also interested in classical knot invariants and their application in mathematics and biological sciences. My joint work with Prof Louis Kauffman on *nodal parity invariants of knotted rigid vertex graphs* discusses the application of this invariant on protein folding classification. I am currently focusing on the following projects dealing with knots and links:

1) Represent knots by rational functions using least possible degree

2) Compute some of the quantum invariants such as Khovanov Homology and Colored Jones polynomials and their categorifications for as many families of knot as possible either by using simple techniques by hand or write effective programs that can perform the computations.

3) Develop some models for DNA as well as RNA/Proteins that can explain folding phenomenon and find a way to design drugs.

For (1) and (2), we use the tools from Real algebraic geometry and+ Representation Theory. For (3) besides understanding both the subjects knot theory and biology, we need some interaction with experimental biologists who can show us how to use electron microscopy so that we can observe knots in concrete situations.

SELECTED PUBLICATIONS

1. Constructing real rational knots by gluing, joint with Shane D'Mello, Topology and its applications, Vol. 237, 2018, Pages 67-81.
2. Some spaces of polynomial knots, joint with Hitesh Raundal, Topology and its applications, Vol. 218, 2017, Pages 66–92
3. Spaces of Polynomial knots in low degree, joint with Hitesh Raundal, Journal of knot theory and its Ramifications, Volume 24, Issue 14, December 2015

SOUMEN MAITY

Associate Professor

soumen@iiserpune.ac.in

Soumen Maity received a PhD from the Theoretical Statistics & Mathematics Unit at Indian Statistical Institute, Kolkata, India in 2002. He has postdoctoral experience from Lund University Sweden; Indian Institute of Management (IIM) Kolkata, India; and University of Ottawa, Canada. Prior to joining IISER Pune in 2009, he was at Indian Institute of Technology (IIT) Guwahati and Indian Institute of Technology (IIT) Kharagpur, India.

DISCRETE MATHEMATICS - COVERING ARRAYS AND SOFTWARE TESTING

Covering arrays are combinatorial objects that have been successfully applied in the design of test suites for testing systems such as software, circuits and networks, where failures can be caused by the interaction between their parameters. The columns of a covering array provide a test suite for software testing. For most applications, it is desirable to construct covering arrays with minimum number of columns. We give an algebraic construction that improves some of the best known covering arrays of strength four with three symbols. We also construct strength three and strength four testing arrays with high coverage.

We perform a new generalization of covering arrays called covering arrays on 3-uniform hypergraphs. This is useful in situations in which some combinations of parameters do not interact; in these cases, we do not insist that these interactions to be tested, which allows reductions in the number of required test cases.

Finally, we consider four most extensively studied graph products in literature and give upper and lower bounds on the size of a covering array on product graph. We find families of graphs for which the size of a covering array on product graph achieves the lower bound.

SELECTED PUBLICATIONS

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Maity, S. and Nayak, A. and Ramsundar, S. (2007). Characterization, Testing and Reconfiguration of Faults in Mesh Networks, *INTEGRATION, the VLSI Journal* Vol. 40: 525-535.

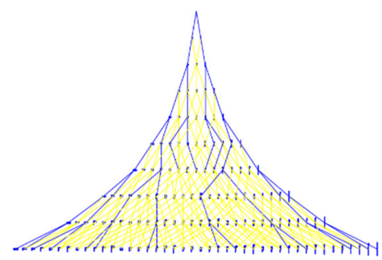
STEVEN SPALLONE

Associate Professor
sspallone@iiserpune.ac.in

Steven Spallone received his PhD from the University of Chicago, USA in 2004. Afterwards he did postdoctoral work at the Max-Planck Institute in Bonn, at Purdue University, and at the University of Oklahoma, USA. He also visited the Tata Institute of Fundamental Research (TIFR) Mumbai, India. He joined the faculty of IISER Pune in July 2012.

PARITY QUESTIONS IN REPRESENTATION THEORY

Recently my research group has been studying determinants of representations, orthogonality of self-dual representations, and the question of which orthogonal representations have a spin structure.



SELECTED PUBLICATIONS

With Arvind Ayyer and Amritanshu Prasad, Representations of symmetric groups with non-trivial determinant. *J. Combin. Theory Ser. A*, to appear.
With Arvind Ayyer and Amritanshu Prasad (2015). Odd partitions in Young's Lattice, Sem. Lothar. Combin. 75:Art. B75g, 13pp.
With Amritanshu Prasad and Pooja Singla (2015). Similarity of matrices over local rings of length two. *Indiana Univ. Math. J.* 64 (2):471-514.

SUPRIYA PISOLKAR

Assistant Professor

supriya@iiserpune.ac.in

Supriya Pisolkar obtained her PhD degree from Harish Chandra Research Institute, Allahabad, India in 2010. She was a postdoctoral fellow at Tata Institute of Fundamental Research, Mumbai for about three years before joining IISER Pune in December 2013.

NUMBER THEORY, GALOIS COHOMOLOGY, ARITHMETIC ASPECTS OF SYMMETRIC SPACES

Broadly speaking, my area of research is number theory and I have been working on problems mostly related to local fields. My thesis deals with questions having a common theme of understanding behavior of norm maps in Galois extensions of local fields. As an application, I computed the Chow group of Zero-cycles of degree zero on Châtelet surfaces over local fields. This work relies on the work of Bloch, Swinnerton-Dyer, Colliot-Téllène, Sansuc.

In joint work with Dr A Hogadi, we proved a conjecture of Hesselholt which predicts the vanishing of the cohomology group $H^1(G(L/K), W(O_L))$ for a Galois extension of local fields L/K. This can be seen as an analogue of Hilbert theorem-90. In the future, I would like to work on generalizations of this result.

Over the last couple of years, I have also been fascinated by arithmetic aspects of locally symmetric spaces which are special type of manifolds. The theory of locally symmetric spaces is a beautiful amalgamation of theory of Lie groups, algebraic groups, analysis, differential geometry, representation theory. In a joint work with Prof CS Rajan and Dr C Bhagwat we have studied questions related to commensurability type problems of these spaces.

Currently, I am interested in understanding the work of Gopal Prasad and Rapinchuk which establishes a connection between arithmetic and geometric aspects of these spaces, giving rise to series of questions in this area.

SELECTED PUBLICATIONS

Pisolkar, S. and Rajan, C.S. (2016). On the splitting fields of generic elements in Zariski dense subgroups. *Journal of Algebra* 457:106-128.

Bhagwat, C.S. and Pisolkar, S. (2016). On uniform lattices in real semisimple groups. *Proceedings of the American Mathematical Society* 144, no. 7, 3151–3156.

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TEJAS KALELKAR

Assistant Professor
tejas@iiserpune.ac.in

After completing his MSc from Indian Institute of Technology, Bombay, Tejas Kalelkar got his PhD from Indian Statistical Institute, Bangalore in 2010. He was then a postdoctoral fellow at Institute of Mathematical Sciences, Chennai and a Chauvenet Postdoctoral Fellow at the Washington University in St Louis, USA. He joined IISER Pune in December 2013.

LOW DIMENSIONAL TOPOLOGY

My area of research is low-dimensional topology. This is a very active area of research with several longstanding conjectures proved fairly recently, like Thurston's Geometrization conjecture (which implies the Poincare conjecture) and the Virtual Fibering conjecture. Within low-dimensional topology I focus mainly on foliations, triangulations and Heegaard splittings of 3-dimensional manifolds.

A closed book looks like a solid 3-dimensional object, but on closer analysis is observed to consist of 2-dimensional pages stacked tightly together. Similarly, every 3-manifold can be built by stacking 2-dimensional surfaces tightly together into what is called a foliation. I am studying a special class of foliations called taut foliations which tell us useful topological properties of the 3-manifold.

On cutting open a 3-manifold along a special embedded surface, called the Heegaard-splitting surface, we end up with two simple pieces called handlebodies. Every closed 3-manifold has such a splitting surface which may not be unique. I am currently working on a structure for these splitting surfaces when a 3-manifold has infinitely many of them.

Every 3-manifold can be built by suitably sticking tetraheda together. Normal surfaces are surfaces embedded particularly `nicely' with respect to such a triangulation. I have proved several results using normal surfaces, such as a weak converse of Haken's well-known result about normality of incompressible surfaces with respect to every triangulation of the 3-manifold.

SELECTED PUBLICATIONS

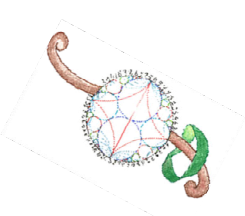
Kalelkar, T. and Phanse, A. An upper bound on Pachner moves relating geometric triangulations (submitted)

Kalelkar, T. and Roberts, R. (2015). Taut foliations in surface bundles with multiple boundary components. *Pacific Journal of Mathematics* 273(2):257-275.

Gadgil, S. and Kalelkar, T. (2013). A Chain complex and Quadrilaterals for normal surfaces. *Rocky Mountain Journal of Mathematics*, 43(2):479-487.

Kalelkar, T. (2009). Incompressibility and normal minimal surfaces. *Geometriae Dedicata* 142(1):61-70.

Kalelkar, T. (2008). Euler characteristic and quadrilaterals of normal surfaces. *Proceedings of the Indian Academy of Sciences Mathematical Sciences* 118(2):227-233.



UTTARA NAIK-NIMBALKAR

Visiting Faculty

uvnaik@iiserpune.ac.in

Uttara Naik-Nimbalkar joined IISER in February 2015. She has about thirty years of teaching and research experience at the University of Pune with visiting positions at the Michigan State University, the University of Edinburgh and University of Waterloo.

STATISTICS

My research interests are in the areas of inference in stochastic processes, survival analysis reliability theory and statistics in finance. Currently I am working on two problems.

(i) Modeling and analysis of statistical dependence: for example, in load sharing systems the failure of a component may reduce (increase) the lifetimes of the surviving components resulting in dependence between their lifetimes. (ii) Hypothesis testing problems in competing risks with missing causes of failure: the failure of a unit is caused by one of the several risks acting on it. It is of interest to know whether some risk dominates the others but sometimes the actual cause of failure for some units is missing.

SELECTED PUBLICATIONS

Dewan, I. and Naik-Nimbalkar, U. On competing risks with masked failures. IMBIC volume "Mathematical and Statistical Applications in Biology, Engineering, Environment and Information Science" edited by Y. P. Chaubey et al., Springer (Accepted for Publication).

Naik Nimbalkar, U. (2016). Likelihood, estimating functions and method of moments. *Mathematics Student* 85(1-2): 63-78.

Sutar, S.S. and Naik-Nimbalkar, U.V. (2016). A model for k-out-of-m load sharing systems. *Communications in Statistics - Theory and Methods* 45(20):5946-5960.

Sutar, S.S. and Naik-Nimbalkar, U.V. (2014). Accelerated failure time models for loadsharing systems. *IEEE Transactions on Reliability* 63(3):706-714.

Deshpande, J.V., Dewan, I. and Naik-Nimbalkar, U.V. (2010). A family of distributions to model load sharing systems. *Journal of Statistical Planning and Inference* 140(6):1441-1451.

Lam, K.F., Deshpande, J.V., Lau, E.H., Naik-Nimbalkar, U.V., Yip, P.S. and Xu, Y. (2009). A test for constant fatality rate of an emerging epidemic, with applications to the SARS syndrome in Hong Kong and Beijing. *Biometrics* 64(3):869-876.

VIVEK MOHAN MALLICK

Assistant Professor
vmallick@iiserpune.ac.in

After completing BStat (1999) and MStat (2001) from Indian Statistical Institute, Vivek Mallick got his PhD from Tata Institute of Fundamental Research (TIFR) Mumbai, India in 2008. He has joined IISER Pune in 2012 after completing his postdoctoral research at the Institute of Mathematical Sciences in Chennai and Centre de Recerca Matematica in Barcelona, Spain.

ALGEBRAIC GEOMETRY

My research can be divided into three categories: intersection theory, derived categories, and T-varieties.

Intersection theory
In intersection theory, one defines invariants of algebraically defined geometric spaces in terms of how the spaces lying on the given space intersect each other. One can study those invariants to determine deep geometric properties of the space.

Derived category
Given a variety (a type of algebraically define geometric space), one can define another algebraic object called derived category. It is known that a lot of the geometric properties of the space translate to algebraic properties of the derived category.

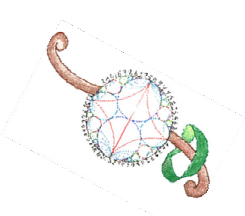
T-variety
While studying an object one many times first determine its group of symmetries. The same holds for varieties. When the group of symmetries contain a torus, one can, with some additional hypothesis describe a variety purely in terms of some combinatorial data. Currently I am working on such varieties.

SELECTED PUBLICATIONS

Dubey, U.V. and Mallick, V.M. (2012). Reconstruction of a superscheme from its derived category. *Journal of the Ramanujan Mathematical Society* 27(4).

Dubey, U.V., Mallick, V.M. (2012). Spectrum of some triangulated categories. *Journal of Algebra* 364:90-118.

Mallick, V.M. (2009). Roitman's theorem for singular projective varieties in arbitrary characteristic. *Journal of K-Theory* 3:501-531.



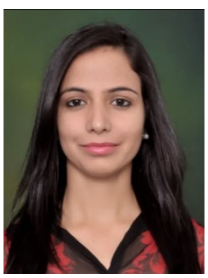
POSTDOCTORAL FELLOWS

Debika Banerjee

Debika did her PhD in Mathematics from Harish-Chandra Research Institute, Allahabad, India and was a postdoctoral fellow at Post Doctoral fellow in Mathematics in Technion, Israel Institute of Technology, Department of Mathematics, Haifa, Israel (2016-17) before joining IISER Pune. Her research interest lies in the study of Divisor problem, Circle problem, Voronoi Summation for- mula and its applications, Distribution of k-free integers and Multiple Zeta functions. She is also interested in Modular Forms, Selberg Trace Formula, Distribution of the eigenvalues of Hecke operators.

D. Banerjee, E. Moshe Baruch and D. Bump, Voronoi Summation Formula for Gaussian integers, in preparation, 2017,

D. Banerjee, E. Moshe Baruch and E. Tenetov, A Voronoi-Oppenheim summation formula for totally real number fields, (under final revision to Journal of Number Theory), 2017



DILPREET KAUR

Dilpreet obtained PhD from IISER Mohali in April 2015. She served as Asisstant Professor in Symbiosis Institute of Technology, Pune for one year after completing her PhD and joined IISER Pune in June 2016 as NBHM- Post Doc Fellow. Her area of interest is Group Theory; in particular, conjugacy classes and representations of finite groups. In her PhD she studied properties of conjugacy classes and representations of special 2-groups. Currently, she is working on classifying z-classes of some well known groups. She is also interested in classifying groups whose all irreducible represenatations of degree greater then 1 are of symplectic type.

Dilpreet, K. and Amit K. (2015). strongly real special 2-groups. *Communications in Algebra* 43(3).

Dilpreet, K. and Amit K. (2015). Character table of real special 2-groups, J. *Ramanujan Math. Soc.* 30(4).

Dilpreet, K. and Amit K. (2015). Quadratic forms in characteristic 2 and a Wedderburn decomposition over rationals. (submitted).

KULDIP SINGH PATEL

Dipramit Majumdar obtained his PhD from the Indian Institute of Technology, Delhi in 2013. He was a visiting scientist in ISI Bangalore from 2013-2014 before joining IISER Pune in 2014. Dipramit's research interest lies in number theory. Even though he is sometimes intrigued by elementary number theoretic problems such as Class Groups and Diophantine equations, his main research interest lies in p-adic families of modular forms.

POSTDOCTORAL FELLOWS

RATNA PAL

Ratna completed her MSc in Mathematics from IIT Kanpur in 2010 and completed PhD from IISc, Bangalore in 2016. She has joined IISER Pune as post-doctoral research fellow in December, 2016. Her research interest lies in Dynamics in Several Complex Variables.

With Kaushal Verma: Dynamical properties of families of holomorphic mappings. *Conform. Geom. Dyn.* 19 (2015), 323–350.
With Sayani Bera (2016). Dynamics of semigroups of entire maps of $mathbb{C}^k$. *Complex Anal. Synerg.* 2(1): Paper No. 2, 22 pp. 32H02 (32H50).

UDAY BHASKAR SHARMA

Uday completed his PhD from the Institute of Mathematical Sciences in August 2016 and joined IISER Pune in January 2017 as a Postdoctoral Research Fellow. His areas of interest are combinatorics and representation theory of finite groups. In his PhD he studied matrices over finite fields in particular and enumerated the simultaneous similarity classes of tuples of commuting matrices over a finite field, which involves using similarity class types (also known as z-classes). Currently, he is working on the problem of enumerating classes of tuples of commuting matrices of some well know matrix groups, and also on two-generator problems of some well known groups. He is also interested in character tables of groups of invertible 2x2 matrices over local rings of finite length.

Uday, B. S. (2016). Simultaneous similarity classes of commuting matrices over a finite field. Linear Algebra and its Applications 501.
Uday, B. S. (2016). Asymptotic of Number of Similarity Classes of Commuting Tuples. Journal of the Ramanujan Mathematical Society 31(4).