30^{th} Annual Conference of
The Ramanujan Mathematical Society

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Indian Institute of Science Education and Research Mohali, Chandigarh
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15-17 May 2015

Programme Schedule and Abstracts

Presidential Address

Plenary Lectures

Special Lecture

Symposia Lectures

Contributed Talks

Panel Discussion

General Body Meeting

Schedule for Plenary Lectures, Symposia and Contributed talks

Venue for Inauguration, Presidential Address, : L5
Venue for General Body Meeting : L6

Time	Friday	Saturday	Sunday
9.00 9.50	Registration Inauguration	Sudhir Ghorpade	Sukumar Adhikari
10.00 10.50	Presidential address	Harold Edwards	Gadadhar Misra
11.00	Tea	Tea	Tea
11.30 12.10	CA Ravi Rao FO Gadadhar Misra NT K. Srinivas TD Anish Ghosh TO Basudeb Datta	CA A. J. Parameswaran FO Sudipta Dutta NT Ram Murty TD Samik Basu TO Ramesh K.	Contributed talks
12.15 12.55	CA J. K. Verma FO Sourav Pal NT D. Surya Ramana TD Stephan Baier TO Anita Naolekar	CA A. Sathaye FO Sudeshna Basu NT Kaneenika Sinha TD Dibyendu De TO Kashyap Rajeevsarathy	Contributed talks
1.00	Lunch	Lunch	Lunch
2.00 2.40	CA Ganesh Kadu FO S. H. Kulkarni NT Madhu Raka TD Allan Haynes TO Ajay Singh Thakur	CA Sagar Kolte FO P. Bandyopadhyay NT R. Thangadurai TD Satya Deo TO Dheeraj Kulkarni	Panel discussion
2.45 3.25	CA B. G. Kang FO Ajay Kumar NT Sudesh Kaur Khanduja TD Gyan Prakash TO Swagata Sarkar	FO Anil Karn NT S. A. Katre	Panel discussion (contd.)
3.30	Tea	Tea	Tea
4.00 4.50	Ram Murty	Parameswaran Sankaran	Valedictory session
5.00 5.50	Avinash Sathaye	GB Meeting	
6.00	Tea & Snacks	Tea & Snacks	
7.30	Dinner	Dinner	Dinner

Presidential Address

Venue : L5

Set Theory and Curvature
Ravi S. Kulkarni, Bhaskaracharya Institute of Mathematics, Pune

Plenary Lectures

Venue : L5

Measurement, Mathematics and Information Technology
M. Ram Murty, Queen's University, Canada

Hyperplane sections of determinantal varieties over finite fields
Sudhir Ghorpade, IIT, Bombay

An Algebraic Theory of Algebraic Curves
Harold Edwards, New York University, USA

Twisted conjugacy in certain PL-homeomorphism groups
Parameswaran Sankaran, IMSc., Bangalore

Two early Ramsey-type theorems in Combinatorial Number Theory:
Some early generalizations and some recent results
Sukumar Adhikari, HRI, Allahabad

Invariants for a class of Cowen-Douglas operators
Gadadhar Misra, IISc., Bangalore

Special Lecture

Venue : L5

(On life and Works of Shreeram Abhyankar)

Glimpses of Affine Algebraic Geometry following Shreeram Abhyankar
Avinash Sathaye, U. Kentucky, USA

Symposia and their Organizers

Subject	**Code**	**Days**	Venue	**Orgnizer**	**Affiliation**
Commutative algebra and Algebraic geometry	CA	Fri, Sat	LH 6	Dilip Patil	IISc, Bangalore
Functional analysis and operator theory	FO	Fri, Sat	LH 1	Amin Sofi	U. of Kashmir, Srinagar
Number theory	NT	Fri, Sat	LH 3	S. Katre	U. of Pune, Pune
Topological Dynamics and applications	TD	Fri, Sat	LH 5	Satya Deo Sukumar Adhikari	HRI, Allahabad
Topology	TO	Fri, Sat	LH 4	Mahuya Datta S. Kumaresan	ISI, Kolkata U. of Hyderabad, Hyderabad

Symposium on Commutative Algebra and Algebraic Geometry

Venue: LH 6

Fri	11.30	Ravi Rao	TIFR, Bombay	Equality of linear and symplectic orbits
Fri	12.15	J. K. Verma	IIT, Bombay	Local cohomology of multi Rees algebras and an extension of Zariski's Product theorem about complete ideals
Fri	2.00	Ganesh Kadu	Pune U., Pune	Hilbert polynomial associated to a derived functor
Fri	2.45	B. G. Kang	Pohang University of Sc. & Technology, Rep. of Korea	TBA
Sat	11.30	A. J Parameswaran	TIFR, Bombay	Autoduality for comapctified Jacobian of a nodal curve
Sat	12.15	A. Sathaye	U. Kentucky, USA	When is a plane a coordinate plane?
Sat	2.00	Sagar Kolte	TIFR, Bombay	TBA

Symposium on Functional analysis and Operator theory

Venue: LH 1

Fri	11.30	Gadadhar Misra	IISc., Bangalore	Curvature inequalities
Fri	12.15	Sourav Pal	ISI, Delhi	Dilation on the symmetrized bidisc
Fri	2.00	S. H. Kulkarni	IIT, Madras	Pseudospectrum of an element of a Banach Algebra
Fri	2.45	Ajay Kumar	University of Delhi	Quantized Functional Analysis
Sat	11.30	Sudipta Dutta	IIT, Kanpur	Subspaces of L_p : The story along the avenue
Sat	12.15	Sudeshna Basu	George Washington U.	Small Combination of slices in Banach spaces
Sat	2.00	P. Bandyopadhyay	ISI, Kolkata	A generalised Korovkins Theorem
Sat	2.45	Anil Karn	NISER, Bhubaneswar	Operator summability in Banach spaces

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Symposium on Number Theory

Venue: LH 3

Fri	11.30	K. Srinivas	IMSc, Chennai	On the zeros of General L-functions
Fri	12.15	D. Surya Ramana	HRI, Allahabad	Large subsets of the integers
Fri	2.00	Madhu Raka	Panjab U., Chandigarh	Non-homogeneous Problems: Conjectures of Minkowski and Woods
Fri	2.45	Sudesh Kaur Khanduja	IISER, Mohali	Dedekind's Theorem on Splitting of Primes: 137 Years of Journey
Sat	11.30	M. Ram Murty	Queen's University, Canada	Twin Primes
Sat	12.15	Kaneenika Sinha	IISER, Pune	Gaps between Hecke eigenvalues
Sat	2.00	R. Thangadurai	HRI, Allahabad	Four Exponential Conjecture
Sat	2.45	S. A. Katre	Pune University, Pune	Uniform cyclotomy, density of primes and zeta functions

Symposium on Topological Dynamics and Applications

Venue: LH 5

Fri	11.30	Anish Ghosh	TIFR, Bombay	Values of quadratic forms at integer points
Fri	12.15	Stephan Baier	Georg-August-Universitat zu Gottingen, Germany	Diophantine approximation on lines with prime constraints
Fri	2.00	Allan Haynes	University of York, England	Repetitivity of patterns of return times for linear toral flows
Fri	2.45	Gyan Prakash	HRI, Allahabad	Linear equations in primes and nilpotent Lie groups
Sat	11.30	Samik Basu	RKMVU, Belur	Tverberg like theorems and equivariant cohomology
Sat	12.15	Dibyendu De	Kalyani University, Kalyani	Higher order Density recurrent sets in countable amenable groups
Sat	2.00	Satya Deo	HRI, Allahabad	On the Colored Tverberg Theorem of Blagojevic, Matschke and Ziegler

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Symposium on Topology

Venue: LH 4

Fri	11.30	Basudeb Datta	IISc. Bangalore	Walkup class $\mathcal{H}^4$ and tight triangulations of 3-manifolds
Fri	12.15	Anita Naolekar	ISI, Bangalore	Deformation cohomology of algebras over operads
Fri	2.00	Ajay Singh Thakur	ISI, Bangalore	On trivialities of characteristic classes over suspension space
Fri	2.45	Swagata Sarkar	IISc., Bangalore	Equivariant cobordism classes of Milnor manifolds
Sat	11.30	Ramesh K.	ISI, Kolkata	Smooth Structures on a fake real projective space
Sat	12.15	Kashyap Rajeevsarathy	IISER, Bhopal	Multicurves and primitivity in $Mod(S_g)$
Sat	2.00	Dheeraj Kulkarni	RKMVU, Belur	Contact Structures and Heegaard Floer Homology

Panel Discussion

Venue : LH 6

Problems and Challenges of Undergraduate Mathematics Education

Chair: I. B. S. Passi, IISER Mohali and Panjab University

Speakers: N. Sathyamurthy (IISER Mohali, Chandigarh) Harold Edwards (New York University, USA), Rajendra Bhatia, (ISI Delhi, Delhi).

Contributed Talks

Parallel Session I

Venue : LH 1

Quaternionic Jørgensen Inequality
Abhishek Mukherjee, Kalna College, Burdwan

On S^0, S^1 and S^3 actions on Spheres, Projective spaces, Lens spaces and Spaces of type (a, b)
Hemant Kumar Singh, University of Delhi, Delhi

Parallel Session II

Venue : LH 3

An analogue of the Artin-Rees lemma for t-rings
Jyoti Singh, Tata Institute of Fundamental Research, Bombay

Reduction of ideals over semi-local Noetherian Rings
Shiv Datt Kumar, Motilal Nehru National Institute of Technology, Allahabad

Abstracts

Abstract of Presidential Address

Set Theory and Curvature

Ravi S. Kulkarni, Bhaskaracharya Institute of Mathematics, Pune

Sets have been used and mentioned from ancient times, and not only in Mathematics. But these references were mainly to finite collections, and their counting in various combinatorial contexts. But the "set theory" as a serious theory for infinite sets arose in the latter half of the 19th century in the works of Dedekind, Cantor, Hausdorff, Peano, Frege, Russel-Whitehead.... Now we take set theory as a foundation of mathematics, which Hilbert described as "a paradise created by Cantor". In the first part of the talk I shall try to explain the three benefits mathematics has derived from set theory.

(1) Set theory provided an ontology for mathematics.
(2) It provided an expression for mathematical thoughts of "space", "number" and "symmetry".
(3) It clarified the notion of infinity.

In the latter part I shall try to explain how this has helped formulating the sophisticated notion of curvature, which is central to differential geometry. We shall briefly review how the notion of curvature has evolved from Newton, Huygens, Euler, Gauss, Riemann, E. Cartan ..... . and how it was used by Einstein for explaining gravity.

Abstracts of Plenary Lectures

Measurement, Mathematics and Information Technology

M. Ram Murty, Queen's University, Ontario, Canada

In this talk, we will highlight the importance of measurement, discuss what can and cannot be measured. Focusing on the measurment of position, importance, and shape, we illustrate by dicussing the mathematics behind, GPS, Google and laser surgery. The talk will be accessible to a wide audience.

Hyperplane sections of determinantal varieties over finite fields

Sudhir R. Ghorpade, Indian Institute of Technology Bombay, Mumbai

Consider the classical determinantal variety defined by the vanishing of all minors of a fixed size of a $m \times n$ matrix whose entries are independent indeterminates over a field F. Alternatively, this is the loci of all $m \times n$ matrices with entries in F and rank not exceeding a fixed integer. This algebraic variety has many nice properties and is of considerable interest in algebraic geometry, combinatorics, invariant theory and representation theory. We view it as a projective variety in $(mn-1)$-dimensional projective space over F and consider its sections by hyperplanes in the ambient projective space. When F is a finite field with q elements, the question of counting the number of rational points of these hyperplane sections turns out to be of interest in coding theory, and has

also a bearing on the geometric properties of the hyperplane sections. In this talk, based mainly on joint work with Peter Beelen, we will attempt to outline a complete answer.

An algebraic theory of algebraic curves

Harold Edwards, New York University, NY, USA

In 1882, two papers that dealt with the theory of algebraic curves were published in Crelle's Journal, one a joint paper by Richard Dedekind and Heinrich Weber, and the other by Leopold Kronecker. The Dedekind-Weber paper is regarded as a founding document of modern algebraic geometry, while the Kronecker paper is largely forgotten. The most memorable characteristic of the Kronecker paper is that it is based on purely algebraic notions and constructions, in sharp contrast to the Dedekind-Weber use of complex numbers, which require a decidedly transcendental construction. The talk will sketch a new approach to the theory of algebraic curves that, like Kronecker's, is based entirely on elementary algebra but retains the geometric imagery of Dedekind-Weber's. The key idea is to use Newton's polygon instead of complex numbers to describe points on a curve.

Twisted conjugacy in certain PL-homeomorphism groups

Parameswaran Sankaran, Institute of Mathematical Sciences, Chennai

Let $\phi : \Gamma \to \Gamma$ be an automorphism of an infinite group. One has an action of Γ on itself defined as $\gamma.x = \gamma x \phi(\gamma^{-1})$. The orbits of this action are called ϕ-twisted conjugacy classes. The number of ϕ-twisted conjugacy classes is called the Reidemeister number of ϕ, denoted $R(\phi)$. If $R(\phi) = \infty$ for every $\phi \in Aut(\Gamma)$, one says that Γ has the $R(\infty)$-property. It is an interesting problem to determine which infinite groups have the $R(\infty)$-property. After a survey of some known results, we will consider certain classes of PL-homeomorphisms of a compact interval which include the Richard Thompson group and their generalizations. The talk is based on joint work (in progress) with D. L. Gonçves and R. Strebel.

The Category of Finite Sets and Algebraic Geometry

Sukumar Das Adhikari, Harish-Chandra Research Institute, Allahabad

Early Ramsey-type theorems include the theorem of Ramsey, and the other results include the celebrated theorem of van der Waerden and a result of Schur. Origins of some of the famous recent developments in mathematics can be traced back to these results. Here we dwell on the Schur and van der Waerden theme - giving some interrelations, having glimpses of different methods employed to deal with these problems, looking at some recent results and open questions.

Invariants for a class of Cowen-Douglas operators

Gadadhar Misra, Indian Institute of Science, Bangalore

The explicit description of irreducible homogeneous operators in the Cowen-Douglas class and the localization of Hilbert modules naturally lead to the definition of a smaller class possessing a flag structure. These operators are shown to be irreducible. It is also shown that the flag structure is rigid, that is, the unitary equivalence class

of the operator and the flag structure determine each other. A complete set of unitary invariants, which are somewhat more tractable than those of an arbitrary operator in the Cowen-Douglas class, are obtained. (This is a joint work with K. Ji, C. Jiang and D. Keshari)

Abstract of the Special Lecture
(On life and Works of Shreeram Abhyankar)

Glimpses of Affine Algebraic Geometry following Shreeram Abhyankar

Avinash Sathaye, U. Kentucky, USA

Algebraic Geometry is the study of varieties defined by polynomial equations. Such varieties are called Affine Varieties. The study naturally evolves into Geometry as well as Algebra. Often, important theorems are deduced by completing the affine varieties to projective varieties, or by local studies using completion at a point. It derives inspirations from Complex Analysis, Function Theory and Topology.
Abhyankar worked on all these different facets of Algebraic Geometry and produced important theorems and conjectures. We shall first give a brief overview of his work and then concentrate on questions of curves and surfaces in small dimensions. This involves the topics in Affine Geometry related to automorphisms and epimorphisms of polynomial rings. We shall start with the first significant theorem Abhyankar-Moh and Suzuki Epimorphism Theorem in two variables and discuss attempts at further extensions. Some discussion of the Jacobian Problem will naturally follow.

Abstracts of Symposia Lectures

Symposium on Commutative Algebra and Algebraic Geometry

Equality of linear and symplectic orbits

Ravi Rao, Tata Institute of Fundamental Research, Bombay

We shall discuss the equality of the elementary and symplectic orbits of a unimodular row of even length. We shall also discuss the same problem over unimodular elements of a symplectic module. This is joint work with Pratyusha Chattopadhyay. We shall indicate some applications to improvement of injective stability results if time permits.

Autoduality for comapctified Jacobian of a nodal curve

A. J. Parameswaran, Tata Institute of Fundamental Research, Bombay

Let Y be a nodal curve and $\bar{J}(Y)$ be its moduli of torsion free sheaves of rank 1. Then we show that the torsion free sheaves of rank 1 on $\bar{J}(Y)$ is isomorphic to $\bar{J}(Y)$ under the map induced by the Abel-Jacobi map $Y \to \bar{J}(Y)$. This is a joint work with Usha Bhosle.

Local cohomology of multi Rees algebras and an extension of Zariski's Product theorem about complete ideals

Jugal K. Verma, Indian Institute of Technology, Bombay

Zariski proved that product of complete ideals is complete in two dimensional regular local rings. This is not true in dimension 3. We provide sufficient conditions in terms local cohomology of multi-Rees algebras for product of complete ideals to be complete in dimension three. This is joint work with Tony Puthenpurakal and Shreedevi Masuti.

Hilbert polynomial associated to a derived functor

Ganesh S. Kadu, University of Pune, Pune

Let A be a Noetherian Cohen-Macaulay local ring of dimension $d \geq 1$. Let M be a finitely generated A-module with $\dim M = d$ and I be an ideal of A. We investigate the following function

$$n \mapsto \ell(\mathsf{Tor}_1^A(M, A/I^{n+1})).$$

We observe that the length above is finite in the following cases and is given by a polynomial for $n >> 0$:
(a) M maximal Cohen-Macaulay, I is locally a complete intersection with $\mathsf{ht}(I) = d-1$ (b) A is an isolated singularity and M is maximal Cohen- Macaulay A-module (c) depth $M = d-1$ and I is either an equimultiple

ideal or an ideal of analytic deviation one. We show that degree of the polynomial is bounded above by $l(I)-1$, where $l(I)$ denotes the analytic spread of I. Moreover, if the degree is less than $l(I)-1$ then it can be shown that the fiber module $F_I(M)$ is free over the fiber cone $F(I)$. In the case when A is one dimensional hypersurface ring and M has rank, it can be shown that the bound above on the degree is attained. We also give an example of a module M not having rank to show that even if the fiber module $F_I(M)$ is free $F(I)$-module, M need not be free A-module. This example suggests that the rank assumption on the module cannot be dropped.

When is a plane a coordinate plane?

Avinash Sathaye, U. Kentucky, USA

We will discuss the Epimorphism Problem in three space. By a plane in three space, we mean a surface f(X,Y,Z) =0 whose coordinate ring is isomorphic to that of a plane Z=0. It is said to be a coordinate plane if f(X,Y,Z) can be arranged to be one of three ring generators of k[X,Y,Z]. We shall discuss known results and open questions.

Symposium on Functional Analysis and Operator Theory

Curvature inequalities

Gadadhar Misra, Indian Institute of Science, Bangalore

The curvature of a contraction in the Cowen-Douglas class of rank one on the unit disc is bounded above by the curvature of the backward shift operator. However, in general, an operator satisfying this curvature inequality need not be contractive. We find a stronger inequality for the curvature which ensures contractivity of the operator. The case of multiply connected domains will be discussed.

Dilation on the symmetrized bidisc

Sourav Pal, Indian Statistical Institute, Delhi

The closed symmetrized bidisc, denoted by Γ, is defined as

$$\Gamma = \{(z_1 + z_2; z_1 z_2) : |z_i| \leq 1; i = 1, 2\}$$

A pair of commuting operators $(S; P)$ for which Γ is a spectral set is called a Γ-contraction. We show that rational dilation succeeds on the symmetrized bidisc by explicitly constructing a normal dilation to a Γ-contraction. This is a joint work with Tirthankar Bhattacharyya and Subrata Shyam Roy.

Pseudospectrum of an element of a Banach Algebra

S. H. Kulkarni, Indian Institute of Technology - Madras, Chennai

Let A be a Banach algebra, $a \in A$ and $\varepsilon > 0$. The ε-pseudospectrum $\Lambda_\varepsilon(a)$ of a is defined by

$$\Lambda_\varepsilon(a) := \{\lambda \in \mathbb{C} : \|(\lambda - a)^{-1}\| \geq \frac{1}{\varepsilon}\}$$

with the convention that $\|(\lambda - a)^{-1}\| = \infty$ if $\lambda - a$ is not invertible. This set contains the spectrum $\sigma(a)$ of a and is contained in the numerical range of a. In this talk we give an overview of the idea of the peudospectrum and discuss some interesting properties including its relationships with the spectrum and numerical range of a. Characterizations of scalar, Hermitian and idempotent elements by means of their pseudospectra are given. It is shown that the pseudospectrum has no isolated points, and has a finite number of components, each containing an element of the spectrum of a. Suppose that for some $\varepsilon > 0$ and $a, b \in A$; $\Lambda_\varepsilon(ax) = \Lambda_\varepsilon(bx)$ for all $x \in A$. It is shown that $a = b$ if:

(i) a is invertible.
(ii) A is semisimple and a is unit regular.
(iii) $A = B(X)$ for a Banach space X.
(iv) A is a C^*-algebra.
(v) A is a commutative semisimple Banach algebra.

Quantized Functional Analysis

Ajay Kumar, University of Delhi, Delhi

We look into the impact of Grothendieck inequality on Classical Banach space theory and the theory of C*-algebras. The talk will review the following topics: (1) Quantum analogue of function spaces (2) Introduction to operator spaces (3) Grothendieck Inequality (4) Tensor products of operator spaces (5) Harmonic analysis and operator spaces (6) Structure of operator space projective tensor product (7) Operator systems

Subspaces of L_p : The story along the avenue

Sudipta Dutta, Indian Institute of Technology - Kanpur, Kanpur

In 40 minutes we try to walk the main avenue along which the story of subspaces of $L_p, 1 < p < \infty$ progressed in last 40 years. We will see questions encountering answers and giving birth to more questions. We will leave the road without much being sure what may wait us ahead - successes or failures. If time permits, we may make a brief visit to tragedy queen L_1, to see what went wrong with her and if she can still find some solace somewhere.

Small Combination of slices in Banach spaces

Sudeshna Basu, George Washington University, USA

In this work, we study certain stability results for Ball Separation properties in Banach Spaces leading to a discussion in the context of operator spaces. In this work, we study certain stability results for Small Combination

of Slices Property (SCSP) leading to a discussion on SCSP in the context of operator spaces. SCS points were first introduced as a slice generalisation of the PC (i.e. point of continuity points for which the identity mapping from weak topology to norm topology is continuous.) It is known that X is strongly regular (respectively X^* is w^*-strongly regular) if and only if every non empty bounded convex set K in X (respectively K in X^*) is contained in the norm closure (respectively w^*- closure)of SCS(K)(respectively w^*-SCS(K)) i.e. the SCS points (w^*- SCS points) of K. Later, it was proved that a Banach space has Radon- Nikodym Property (RNP) if and only if it is strongly regular and it has the Krein-Milamn Property(KMP). Subsequently, the concepts of SCS points was used to investigate the structure of non-dentable closed bounded convex sets in Banach spaces. The point version of the result was also shown to be true.

A generalised Korovkins Theorem

Pradipta Bandyopadhyay, Indian Statistical Institute, Kolkata

In this talk, we will present a generalized version of Korovkins theorem and give some examples to illuminate our points of departure from its more familiar cousins.

Operator summability in Banach spaces

Anil Karn, National Institute of Science Education and Research, Bhubaneswar

We propose a new kind of summability in Banach spaces which, in general, is different from weak- and norm-p-summabilities. We relate it to two different types of geometric properties in Banach spaces, namely, Gelfand-Phillips property and Dunford- Pettis property.

Symposium on Number Theory

On the zeros of General L-functions

K. Srinivas, Institute of Mathematical Sciences, Chennai

Selberg defined a class of functions (popularly known as Selberg class) having properties similar to the Riemann zeta-function. Selberg class is full of open problems. In this talk, we shall discuss some results related to the zeros of functions in this class.

Large subsets of the integers

D. Surya Ramana, Harish-Chandra Research Institute, Allahabad

The talk is centered around the following somewhat vaguely phrased question : do large but otherwise arbitrary subsets of interesting subsets of the integers such as the primes, the squares etc retain some of their properties ? For instance, every large enough natural number is a sum of no more than four prime numbers. Then one

may ask, given a subset of positive density in the primes, what is the smallest number of summands required to represent all large enough natural numbers as a sum of primes from this dense subset.
We will begin our talk by giving a number of other examples, some conjectures and some theorems, that clarify the meaning of this question and then proceed to describe our recent work that falls within this theme.

Non-homogeneous Problems: Conjectures of Minkowski and Woods

Madhu Raka, Panjab University, Chandigarh

A classical conjecture in Geometry of Numbers attributed to H. Minkowski states that if

$$L_i = a_{i1}x_1 + \cdots + a_{in}x_n,\ 1 \leq i \leq n$$

are n real linear forms in n variables $x_1, \ldots, x_n$ and of determinant $\Delta = \det(a_{ij}) \neq 0$, then given any real numbers $c_1, \ldots, c_n$, there exists integers $x_1, \ldots, x_n$ satisfying

$$| (L_1 + c_1) \cdots (L_n + c_n) | \leq \frac{1}{2^n} | \Delta | .$$

Equality is necessary if and only if after a suitable unimodular transformation the linear forms L_i have the form $2c_ix_i$ for $1 \leq i \leq n$.
In this talk, we shall give the history of the Conjecture and the recent progress to settle it for $n \leq 9$. Following Remak-Davenport Approach and using a result of McMullen [2005], it is sufficient to prove Woods' Conjecture for lattices reduced in the sense of Korkine and Zolotareff. We shall illustrate the difficulties we face in proving Woods' Conjecture for higher dimensions. For $n \geq 10$, we obtain estimates to Minkowski's Conjecture improving the previous known results.

Dedekind's Theorem on Splitting of Primes: 137 Years of Journey

Sudesh K. Khanduja, Indian Institute of Science Education and Research, Mohali

Let $K = \mathbb{Q}(\theta)$ be an algebraic number field with $f(x)$ as the minimal polynomial of the algebraic integer θ over $\mathbb{Q}$. Let p be a rational prime.Let

$$\bar{f}(x) = \bar{g}_1(x)^{e_1} \ldots \bar{g}_r(x)^{e_r}$$

be the factorization of $\bar{f}(x)$ as a product of powers of distinct irreducible polynomials over $\mathbb{Z}/p\mathbb{Z}$, with $g_i(x)$ monic polynomials belonging to $\mathbb{Z}[x]$. In 1878, Dedekind proved if p does not divide the index of the subgroup $\mathbb{Z}[\theta]$ in A_K, then $pA_K = \wp_1^{e_1} \ldots \wp_r^{e_r}$, where $\wp_1, \ldots, \wp_r$ are distinct prime ideals of A_K, $\wp_i = pA_K + g_i(\theta)A_K$ with residual degree of $\wp_i/p$ equal to $\deg g_i(x)$ for all i. In 2008, we proved that converse of Dedekind's theorem holds, i.e. if for a rational prime p the decomposition of pA_K satisfies the above three properties, then p does not divide $[A_K : \mathbb{Z}[\theta]]$. Dedekind also gave a simple criterion known as Dedekind Criterion to verify when p does not divide $[A_K : \mathbb{Z}[\theta]]$. We will also discuss the Dedekind Criterion and its generalization. In 2014, we have proved the analogue of Dedekind's theorem for finite extensions of valued fields of arbitrary rank as well as its converse.

Twin Primes

M. Ram Murty, Queen's University, Ontario, Canada

The twin prime problem is the assertion that there are infinitely many distinct primes p, q with $|p-q| = 2$. This is still an open problem. In May 2013, Yitang Zhang surprised the world by proving that there are infinitely many pairs of distinct primes p, q such that $|p - q| < 70$ million. Until Zhang's work, no bound was known. After Zhang's paper, this bound has been improved and in November 2013, Maynard and Tao gave a simplified proof of Zhang's theorem with better numerical results. The bound now is 246. We will survey these developments and outline a new higher rank sieve. As a consequence, the Zhang-Maynard-Tao theorem is deduced as a special case of a more general result. This general result leads to improvements on earlier work of Heath-Brown on prime k-tuples. This is joint work with Akshaa Vatwani.

Gaps between Hecke eigenvalues

Kaneenika Sinha, Indian Institute of Science Education and Research, Pune

We will derive some new results about the behaviour of gaps between the eigenvalues of the Hecke operator acting on modular cusp forms. This is a joint work with Sudhir Pujahari.

Four Exponential Conjecture

R. Thangadurai, Harish-Chandra Research Institute, Allahabad

Let x and y be Q-linearly independent complex numbers and a and b be Q-linearly independent complex numbers. Then Four Exponential Conjecture says that among the four numbers $\exp(ax), \exp(bx), \exp(ay), \exp(by)$, at least one of them is transcendental. We shall report the recent work on this conjecture.

Uniform cyclotomy, density of primes and zeta functions

S. A. Katre, SP Pune University, Pune

In this talk we shall consider the condition of uniform cyclotomy, and get the density of primes which satisfy this condition. We then find the zeta function of the projective curve $aY^e = bX^e + cZ^e$ and hence the divisor class number of this curve in the case of uniform cyclotomy.

Symposium on Topological Dynamics and Applications

Values of quadratic forms at integer points

Anish Ghosh, Tata Institute of Fundamental Reseach, Bombay

An old conjecture of Oppenheim and Davenport, now a famous theorem of Margulis, states that the set of values at integer points, of an indefinite irrational quadratic form in at least three variables is dense in the real line. An observation of Raghunathan relating this problem to dynamics of flows on homogeneous spaces was key to Margulis' proof. I will discuss some recent developments which aim to obtain effective versions of Margulis' theorem. Joint work with A. Gorodnik and A. Nevo.

Diophantine approximation on lines with prime constraints

Stephan Baier, Georg-August-Universitat zu Gottingen, Germany

This is joint work with Anish Ghosh. We investigate simultaneous Diophantine approximation with prime numerators and denominators on lines in the plane with irrational slopes. Our work is inspired by results of G. Harman and H. Jones on a similar question for functions $f(x) = x^\tau$, where $\tau > 0$. Our approach combines the method of Harman and Jones with estimates for exponential sums in several variables, where the Diophantine properties of the said slopes come into play. We also discuss potential generalizations of our results to manifolds.

Repetitivity of patterns of return times for linear toral flows

Alan Haynes, University of York, UK

A discrete set Y in $\mathbb{R}^d$ is said to be linearly repetitive if there exists a constant $C > 0$ such that every pattern of diameter r, which occurs somewhere in Y, occurs in every ball of diameter Cr in $\mathbb{R}^d$. In this talk we will focus on the case when Y is a 'cut and project set', i.e. the collection of return times to a canonical region of a linear $\mathbb{R}^d$ action on a higher dimensional torus. We will provide a characterization of the collection of all linearly repetitive cut and project sets, answering a question posed by Lagarias and Pleasants. If time permits, we will also discuss a connection to the Littlewood Conjecture in Diophantine approximation.

Linear equations in primes and nilpotent Lie groups

Gyan Prakash, Harish-Chandra Research Institute, Allahabad

Ben Green and Terence Tao, in 2006, obtained an asymptotics for the number of k-term arithmetic progressions (more generally solutions of a system of a system of linear equations satisfying certain constraints) contained in the set of primes. This was obtained by assuming the following two major conjectures, one being the inverse Gowers norm conjecture and the other being Möbius nilsequence conjecture. The inverse Gowers norm conjecture was later proved by Green, Tao and Ziegler. The Möbius nilsequence conjecture, which is a special

case of Sarnak's conjecture was proved by Green and Tao. In this survey talk, we shall give an exposition of this topic.

Tverberg like theorems and equivariant cohomology

Samik Basu, Ramkrishna Mission Vivekananda University, Belur

The Tverberg Theorem proved in 1966 deals with intersecting convex hulls of points in Euclidean space. There is an interesting topological version which is a conjecture about intersecting disjoint faces of a continuous image of a simplex. Usual techniques used here are generalised Borsuk-Ulam theorems and ideal valued obstructions. We use techniques from equivariant homotopy theory to obtain similar results.

Higher order Density recurrent sets in countable amenable groups

Dibyendu De, University of Kalyani, Kalyani

A subset A of $\mathbb{N}$ is said to have positive upper density if $\overline{d}(A) = \limsup_n \frac{|A\cap\{1,2,\ldots,n\}|}{n} > 0$. Celebrated Szemeredi's Theorem states that every subset of $\mathbb{N}$ with positive upper density contains arithmetic progression of arbitrary length. This Theorem ensures the definition of k-*density intersective* sets : a subset $S \subset \mathbb{N}$ is called k-*density intersective* if for every subset A of $\mathbb{N}$, with positive upper density (that is $\overline{d}(A) > 0$) there exists $d \in \mathbb{N}$ such that $A \cap (-d + A) \cap \ldots \cap (-(k-1)d + A) \neq \emptyset$. On the other hand a subset $S \subset \mathbb{N}$ is called k-*density recurrent* if for every subset A of $\mathbb{N}$ with positive upper density there exists $d \in \mathbb{N}$ such that $\overline{d}(A \cap (-d + A) \cap \ldots \cap (-(k-1)d + A)) > 0$. This is clear from the definition that k-*density recurrent* sets are k-*density intersective*. On the other hand, it is the work of Furstenberg and Katznelson that k-*density intersective* sets are also k-*density recurrent*. We extend this result for arbitrary amenable groups for the case $k = 2$, where an amenable group is one, in which there exists a left invariant probability measure. Finally we show that for an amenable group G the set $\mathcal{DR}_2(G)$ of ultrafilters on G, every member of which is density 2-recurrent, is a compact subsemigroup of the Stone-Čech compactification βG of G containing the minimnal idempotents of βG.

On the Colored Tverberg Theorem of Blagojevic, Matschke and Ziegler

Satya Deo, Harish-Chandra Research Institute, Allahabad.

Let $d \geq 1, r \geq 2$, a prime and $N = (d+1)(r-1)$. The Topological Tverberg Theorem says that if Δ_N is the N-simplex and $f : \Delta_N \to \mathbb{R}^d$ is a continuous map, then we can always find a family $F_1, F_2 \cdots F_r$ of r disjoint faces of Δ_N whose f-images will have a nonempty intersection. We will present a survey talk on the above topological Tverberg Theorem culminating into the BMZ theorem which has been acclaimed as the most satisfactory and surprising form of the colored topological Tverberg theorem.

Symposium on Topology

Walkup class $\mathcal{H}^4$ and tight triangulations of 3-manifolds

Basudeb Datta, Indian Institute of Science, Bangalore

A triangulated $(d+1)$-manifold with non-empty boundary is said to be *stacked* if all its interior faces have dimension $\geq d$. A closed triangulated d-manifold M is said to be *stacked* if $M = \partial N$ for some stacked triangulated $(d+1)$-manifold N. A triangulated manifold is said to be *locally stacked* if each vertex link is a stacked sphere.
For $d \geq 3$, we recursively define the class $\mathcal{H}^d(k)$ as follows. (a) $\mathcal{H}^d(0)$ is the set of stacked $(d-1)$-spheres. (b) A triangulated d-manifold Y is in $\mathcal{H}^d(k+1)$ if it is obtained from a member of $\mathcal{H}^d(k)$ by a combinatorial handle addition. (c) The *Walkup's class* $\mathcal{H}^d$ is the union $\mathcal{H}^d = \bigcup_{k\geq 0} \mathcal{H}^d(k)$.
For a field $\mathbb{F}$, a simplicial complex X is called $\mathbb{F}$-*tight* if (i) X is connected, and (ii) for all induced subcomplexes Y of X and for all $0 \leq j \leq \dim(X)$, the morphism $H_j(Y;\mathbb{F}) \to H_j(X;\mathbb{F})$ induced by the inclusion map $Y \hookrightarrow X$ is injective. For $d \geq 3$, a triangulated d-manifold M is called *tight neighborly* if $\beta_1(M;\mathbb{Z}_2) = \binom{f_0(M)-d-1}{2} / \binom{d+2}{2}$.
In this talk we would like to discuss the following recent results which are joint work with B. Bagchi and J. Spreer; B. A. Burton, N. Singh and J. Spreer; S. Murai.

Theorem 1. *Let M be a closed triangulated 3-manifold. If M is tight neighborly then M is locally stacked and $\mathbb{F}$-tight.*

Theorem 2. *For $d \geq 2$, a connected triangulated d-manifold M without boundary is stacked if and only if $M \in \mathcal{H}^{d+1}$.*

Theorem 3. *If a triangulated closed 3-manifold M is tight with respect to some field $\mathbb{F}$ with $\mathrm{char}(\mathbb{F}) \neq 2$ then M is stacked.*

As a consequence of the above results we obtain:

Corollary. *Let M be a connected, orientable, closed triangulated 3-manifold and $\mathbb{F}$ be a field with $\mathrm{char}(\mathbb{F}) \neq 2$. Then the following are equivalent.* (i) *M is tight-neighborly.* (ii) *M is a neighborly member of $\mathcal{H}^4$.* (iii) *M is neighborly and stacked.* (iv) *M is $\mathbb{F}$-tight.*

Deformation cohomology of algebras over operads

Anita Naolekar, Indian Statistical Institute, Bangalore

An algebra of a certain type is usually defined by generating operations and relations. Given a type of algebras there is a notion of free algebra over a generic vector space V, say $\mathcal{P}(V)$. Viewed as a functor from the category $Vect$ of vector spaces to itself, $\mathcal{P}$ is equipped with a monoid structure, that is a transformation of functors $\gamma : \mathcal{P} \circ \mathcal{P} \to \mathcal{P}$, which is associative, and another one $\eta : I \to \mathcal{P}$ which is a unit. The existence of this structure follows readily from the universal properties of free algebras. Such a data $(\mathcal{P}; \gamma; \eta)$ is called an algebraic operad. On the other hand, any operad gives rise to a type of algebras, the $\mathcal{P}$-algebras. Given a $\mathcal{P}$-algebra structure, we

introduce the cohomology of this structure, and finally, after defining deformations of this structure, we show that this cohomology controls the deformations.

On trivialities of characteristic classes over suspension space

Ajay Singh Thakur, Indian Statistical Institute, Bangalore

A CW-complex X is said to be W-trivial if for any vector bundle ξ over X, the total Stiefel-Whitney class $W(\xi) = 1$. It is a theorem of Atiyah-Hirzebruch that the k-fold suspension $\Sigma^k X$ of any CW-complex X is W-trivial if $k > 8$. A related notion is that of C-triviality. A CW-complex X is said to be C-trivial if for any complex vector bundle η over X, the total Chern class $C(\eta) = 1$. In this talk we shall state some general results and investigate when the iterated suspensions of projective spaces are W-trivial and C-trivial.

Equivariant cobordism classes of Milnor manifolds

Swagata Sarkar, Indian Institute of Science, Bangalore

Let $\mathcal{N}_*$ be the unoriented cobordism algebra, let $G = (\mathbb{Z}_2)^n$, and let $Z_*(G)$ denote the equivariant cobordism algebra of G-manifolds with finite stationary point sets. Further, let $\epsilon_* : Z_*(G) \to \mathcal{N}_*$ be the homomorphism which forgets the G-action. A cobordism class $[M] \in Z_*(G)$ is said to be indecomposable if it cannot be expressed as the sum of products of lower dimensional cobordism classes. Indecomposable classes generate the cobordism algebra $Z_*(G)$. We discuss a sufficient criteria for 'indecomposability'. Using the above mentioned criterion, we show that the classes of Milnor manifolds (degree 1 hypersurfaces in $\mathbb{R}P^m \times \mathbb{R}P^n$) give non-trivial, indecomposable elements in $Z_*(G)$ in degrees up to $2^n - 5$. Moreover, we show that in most cases these elements can be arranged to be in $Ker(\epsilon_*)$. We also give a lower bound for the number of linearly independent elements in $Z_d((\mathbb{Z}_2)^k)$, where $1 \leq d \leq 2^{k-i+1} - 5$. (This talk is based on joint work with Samik Basu and Goutam Mukherjee.)

Smooth Structures on a fake real projective space

Ramesh K., Indian Statistical Institute, Kolkata

In this talk, we first study the group of smooth homotopy m-spheres Θ_m due to Michel Kervaire and John Milnor (1963). By using the group Θ_7, we classify, up to diffeomorphism, all closed manifolds homeomorphic to the real projective 7-space $\mathbb{R}P^7$. We also show that if M is a closed smooth manifold homotopy equivalent to $\mathbb{R}P^7$, then M has exactly 56 distinct differentiable structures up to diffeomorphism.

Multicurves and primitivity in $Mod(S_g)$

Kashyap Rajeevsarathy, Indian Institute of Science Education and Research, Bhopal

Let S_g be a closed orientable surface of genus $g = 2$, and let $\mathcal{C} = \{c_1, \ldots, c_m\}$ be multicurve in S_g. Since the Dehn about any two distinct curves in $\mathcal{C}$ commute in the mapping class group $Mod(S_g)$, the Dehn twist $t_{\mathcal{C}} = t_{c_1} t_{c_2} \ldots t_{c_m}$ about $\mathcal{C}$ is well-defined.

A root h of $t_{\mathcal{C}}$ may either fix the curves in $\mathcal{C}$ or permute them, and accordingly h will be classified as permuting or nonpermuting. We will describe the geometric construction of permuting and nonpermuting roots, and derive equivalent conditions for their existence. We will also discuss some recent results pertaining to this problem. Finally, we will give a deeper insight into the problem of general primitivity in $Mod(S_g)$.

Contact Structures and Heegaard Floer Homology

Dheeraj Kulkarni, Ramkrishna Mission Vivekananda University, Belur

There is a dichotomy between contact structures – tight and overtwisted. Classification of overtwisted contact structures up to isotopy, due to Eliashberg, is well-known. There have been few results towards classification of tight contact structures. However, in general, given a contact structure it is difficult to know whether it is tight or not. In this talk, we focus on the role of certain element, called as contact invariant, of Heegaard Floer homology group associated with a given contact structure in understanding tightness. We discuss success and limitations of contact invariant in detecting tightness of contact structures. In this direction, I will also present a recent result from joint work with James Conway and Amey Kaloti. We will briefly survey relevant notions from Contact Topology and Heegaard Floer Homology in first half of the talk. The audience will have a glimpse of "soft" meadows and "rigid" rocky features in the terrain of Contact Topology.

Ramanujan Mathematical Society

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NOTICE
30TH RMS ANNUAL GB MEETING - 2015

Date : May 16th, 2015.
Venue : IISER, Mohali, Chandigarh.
Time : 5 PM

AGENDA

(1) Welcome by the Secretary.

(2) Remarks by the President.

(3) Confirmation of the minutes of the last GB meeting.

(4) Secretary's report including the admission of life members of RMS for the year 2014-15.

(5) Report of Academic Secretary.

(6) Audited statements of accounts.

(7) Reports of editors of
1. JRMS, 2.RMS LNS 3. RMS Newsletter 4. RMS Little Mathematics Treasures.

(8) Venue of next RMS Annual meeting.

(9) Slate for the next RMS EC for the period 1st April 2016 to 31 March 2019 : Recommendations of the present EC.

(10) RMS office building at National College (NC), Tiruchirapalli and MoU between RMS and NC.

(11) Any other matter with the permission of the Chair.

(12) Vote of thanks.

All life members are requested to attend the GB meeting.

Sd/
K Srinivas,
Secretary, RMS, 23rd March 2015

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