National Conference on Algebra, Analysis, Coding and Cryptography

in honor of Prof. Bal Kishan Dass on the occasion of his retirement

October 14-15, 2016

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Department of Mathematics

University of Delhi, Delhi 110 007, India

Prof. B. K. Dass

Prof. B. K. Dass was Professor in the Department of Mathematics and Dean, Faculty of Technology, University of Delhi. He has been Head, Department of Mathematics and Dean, Faculty of Mathematical Sciences of University of Delhi. His research interests include Coding Theory, Information Theory, Cryptography, Applied Algebra, and Discrete Mathematics. He has published over 100 research papers and has edited 7 books, apart from supervising 30 Ph.D. candidates and over a dozen M.Phil. students. He has widely traveled to several countries and has delivered more than 150 lectures outside India in different universities and research institutions including several invited /plenary/keynote lectures at various conferences. He has collaborated research with as many as 20 scholars from outside India and has published work with them.

Prof. Dass was elected President of Mathematical Sciences section of Indian Science Congress Association 2008-2009. He was Chairman of National Committee of ”India Mathematics Year 2009” of Ministry of Science and Technology. He was also elected as President of Academy of Discrete Mathematics and Applications. He has been responsible as a member of the committees for setting up several Centres of Mathematical Sciences in India at Kerala, Banaras Hindu University, Banasthali University (Rajasthan), Indian Institute of Science (Bangalore), C.R. Rao institute at Hyderabad. He was appointed as Chairman of the committee of the initiative “Human Resource Development in Mathematics” initiated by the Department of Science & Technology, Govt. of India. He was appointed as Ambassador of International Congress of Mathematicians 2014 held in South Korea in August 2014. He is currently President of “Forum for Interdisciplinary Mathematics” a leading international mathematical society.

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University of Delhi

Dr. D. K. Singh
University of Delhi

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About the Department

In University of Delhi, Department of Mathematics was started in 1947 and in 1957 a post-graduate course in Mathematical Statistics was initiated. The department was therefore renamed as Department of Mathematics and Mathematical Statistics. In 1963 a two year postgraduate course in Operational Research was instituted under this department. As such the department expanded considerably and so did its activities. Consequently in December 1964 the Faculty of Mathematics was formed and in August 1973 the only department under the Faculty was divided into four departments, viz., Department of Mathematics, Department of Statistics, Department of Operational Research, and Department of Computer Science.

The impressive tradition of the Department of Mathematics derives its roots from the east which predates the formation of the post graduate department. Encompassed within the tradition are names such as P. L. Bhatnagar, J. N. Kapur, A. N. Mitra, and B. R. Seth, all of whom distinguished themselves by their teaching and research and who later carved out major roles for themselves on the Indian mathematical scenario even though they were not directly associated with the post-graduate department.

The post-graduate department was set up in 1947. It was fortunate to have Professor Ram Behari as its first head. Prof. Ram Behari was an eminent mathematician who specialised in the important field of Differential Geometry. He can be credited with having started the tradition of research in Differential Geometry, one of the first disciplines in pure mathematics to have been pursued in the department. He guided a number of research scholars and established the high traditions of teaching in the department. During his tenure, in 1957, the department also initiated an M.A./M.Sc. program in Mathematical Statistics and the department was designated as the Department of Mathematics and Mathematical Statistics.

In 1962, the department was given a formidable push when a distinguished mathematician, Prof. R. S. Varma, assumed the responsibilities of the head. It was entirely due to his dynamism and academic breadth that research activities in the department blossomed in several directions such as Operational Research, Information Theory, Coding Theory, Space Dynamics and in Complex Analysis. The first masters program in Operational Research in the country was started in this department under his leadership. This was even before any university in the U.K. and in several other advanced countries had done so. Since the activities and the courses in the department were now so wide and varied the department was enlarged into the Faculty of Mathematics at the initiative of Prof. R. S. Varma and he was appointed as the first Dean.

In 1970, another distinguished mathematician, Prof. U. N. Singh, was appointed the Head of the Department and the Dean of the Faculty of Mathematics. He provided the department with the requisite strength and depth in the core areas of mathematics. He created strong research in Functional Analysis, Harmonic Analysis, and in Operator Theory. During his stewardship of the department, several distinguished mathematicians from all over the globe began to visit the department regularly and the department can be said to have attained full maturity. He foresaw the need to have separate departments within the overall set-up of the Faculty of Mathematics and thus were created, in 1973, the Department of Mathematics, the Department of Statistics, the Department of Operational Research and the Department of Computer Science. The Faculty of Mathematics was re-designated as the Faculty of Mathematical Sciences.

The Department currently offers M.A./M.Sc. courses and runs M.Phil., and Ph.D. programs in Mathematics.

Faculty and their Research Specializations

The area(s) of expertise of the faculty members of the department are given below

Professors	
Dinesh Singh dsingh@maths.du.ac.in	Banach Algebras, Complex Analysis, Functional Analysis
Tej B. Singh tbsingh@maths.du.ac.in	Algebraic Topology
Ajay Kumar akumar@maths.du.ac.in	Harmonic Analysis, Complex Analysis, Operator Algebras
V. Ravichandran (HOD) vravi68@gmail.com	Complex Analysis
Tarun Das tarukd@gmail.com	General Topology, Dynamical systems and Ergodic Theory
C. S. Lalitha cslalitha1@gmail.com	Mathematical Programming, Optimization Theory
Ruchi Das rdasmsu@gmail.com	General Topology, Dynamical Systems and Ergodic Theory
Associate Professors	
Sachi Srivastava sachi_srivastava@yahoo.com	Functional Analysis, Operator Theory, Abstract Differential Equations, Operator Algebras
Vusala Ambethkar vambethkar@maths.du.ac.in	Computational Fluid Mechanics

Assistant Professors	
Ratikanta Panda rkpanda@maths.du.ac.in	Analysis of PDE, Nonlinear Functional Analysis
A. Zothansanga azothansanga26@yahoo.com	Functional Analysis
Lalit Kumar lalitkvashisht@gmail.com	Frames, Wavelets, Functional Analysis
Anupama Panigrahi anupama.panigrahi@gmail.com	Number Theory, Cryptography, Information Security
Arvind Patel apatel@maths.du.ac.in	Fluid Dnamics, Computational Fluid Dynamics, PDE
Kanchan Joshi kanchan.joshi@gmail.com	Algebra: Non-Commutative Group Rings
Atul Gaur agaur@maths.du.ac.in	Commutative Algebra
Hemant Kumar Singh hksinghdu@gmail.com	Algebraic Topology
Anuj Bishnoi anuj.bshn@gmail.com	Field Theory and Polynomials
Pratima Rai pratimarai5@gmail.com	Numerical analysis, Differential equations
Sachin Kumar sachinambariya@gmail.com	Differential Equations, General Relativity
Surendra Kumar surendraiitr8@gmail.com	Ordinary differential equations, Systems theory; control
Ranjana Jain rjain.math@gmail.com	Functional Analysis, Operator Spaces, Operator Algebras
Randheer Singh randheernsit@gmail.com	Partial Differential Equations, Nonlinear Waves

Programme

Day 1: October14, 2016

Venue: Room No. 5, Satyakam Bhavan

08:30 am - 09:30 am	Registration
09:30 am - 10:00 am	Inaugural function
10:00 am - 10:30 am	**High Tea**
10:30 am - 11:15 am	*Some Research Contributions of Prof. B. K. Dass* Dr. Poonam Garg and Dr. Surbhi Madan
Session I: Plenary Talks	
11:15 am - 12:00 pm	*Analyzing Functional Connectivity Patterns of the Brain* Prof. G. Rangarajan Indian Institute of Science, Bangalore **Chair:** Prof. S. G. Dani
12:00 pm - 12:45 pm	*Continued fraction expansions for complex numbers* Prof. S. G. Dani Indian Institute of Technology, Bombay **Chair:** G. Rangarajan
Session II: Invited Talks **Chair:** Prof. Prem Nath	
12:45 pm - 01:15 pm	*Some Cryptosystems* Prof. R. K. Sharma Indian Institute of Technology, Delhi
01:15 pm - 02:00 pm	**Lunch**
02:00 pm - 02:30 pm	*Enumeration formula for complementary-dual cyclic additive codes* Dr. Anuradha Sharma Indraprastha Institute of Information Technology, Delhi
02:30 pm - 03:00 pm	*Quadratic residue codes over the ring* $\mathbb{F}_P/\langle u^m - u\rangle$ *and their Gray images* Prof. Madhu Raka Panjab University, Chandigarh

Day 1: October 14, 2016

03:00 pm - 03:30 pm	*Cayley-Hamilton Theorem for Mixed Diccriminant* Prof. R. P. Bapat Indian Statistical Institute, Delhi
03:30 pm - 04:30 pm	**Paper Presentation (Parallel Sessions)**
04:30 pm - 04:45 pm	**Tea Break**
04:45 pm - 06:30 pm	**Paper Presentation (Parallel Sessions)**

Day 2: October 15, 2016

Session I: Invited Talks **Chair:** Dr. Sachi Srivastava	
10:00 am - 10:30 am	*Wavelets and Applications* Prof. Khalil Ahmad Jamia Millia Islamia, Delhi
10:30 am - 11:00 am	*Spectral behavior of some special matrices* Dr. Tanvi Jain Indian Statistical Institute, Delhi
11:00 am - 11:30 am	**Tea Break**
Session II: Invited Talks **Chair:** Prof. Ruchi Das	
11:30 am - 12:00 pm	*Polynomial Systems and Projective Reed-Muller Codes* Prof. S. R. Ghorpade Indian Institute of Technology, Bombay
12:00 pm - 12:30 pm	*Recent Trends in Internet Technologies in Mathematics Education: Some Practical Experiences and Lessons Learnt* Prof. Om Ahuja Kent State University, USA
12:30 pm - 01:00 pm	*Dynamic Model of Online Social Network using Signed Graphs* Dr. Deepa Sinha South Asian University, Delhi
01:00 pm - 02:00 pm	**Lunch**
02:00 pm - 03:30 pm	**Paper Presentation (Parallel Sessions)**
03:30 pm - 03:45 pm	**Tea Break**
03:45 pm - 05:00 pm	**Paper Presentation (Parallel Sessions)**

Parallel Sessions

Day 1: R-5, Satyakam Bhawan
Parallel Session: I (Analysis)
Time: 03:30 pm - 04:30 pm

1. *An extension of uncertainty principle to generalized wavelet transform*
   Ishtaq Ahmad

2. *Certain characterizations of orthogonal Gabor systems on local fields*
   Owais Ahmad

3. *Continuous weaving frames*
   Deepshikha

4. *Perturbation of frames in locally convex spaces*
   Saakshi Garg

Day 1: R-4, Satyakam Bhawan
Parallel Session: II (Coding)
Time: 03:30 pm - 04:30 pm

1. *Construction of m-repeated burst error detecting and correcting non-binary linear codes*
   Dr. Rashmi Verma

2. *Perfect and MDS poset block codes*
   Namita Sharma

Day 1: R-2, Satyakam Bhawan
Parallel Session: III (Optimization)
Time: 03:30 pm - 04:30 pm

1. *KT-pseudoinvex interval valued optimization problem*
   Bharti Sharma

2. *Set optimization using improvement sets*
   Mansi Dhingra

3. *An Algorithm for solving the problem of industry by formulating it as a capacitated transportation problem*
   Kavita Gupta

4. *Linear fractional bi-level programming problem with multi-choice parameters*
   Ritu Arora

Tea Break: 04:30 pm - 04:45 pm

Day 1: R-5, Satyakam Bhawan
Parallel Session: IV (Analysis)
Time: 04:45 pm - 06:30 pm

1. *Weyl Theory for bounded and unbounded operators - A comparative study*
   Dr. Anuradha Gupta

2. *On B^*-Continuous multifunctions and its selection in B^*-cluster system*
   Chandrani Basu

3. *Approximation of signals in Lebesgue spaces*
   Dr. Vishnu Narayan Misra

4. *Some ideal convergent multiplier sequence spaces using de la Valleee Poussin mean and Zweier operator*
   Dr. Tanweer Jalal

5. *z-Perfectly continuous functions*
   Manoj Kumar Rana

Day 1: R-4, Satyakam Bhawan
Parallel Session: V (Algebra/Coding/Cryptography)
Time: 04:45 pm - 06:30 pm

1. *Neeva: A Lightweight Hash functions*
   Khushboo Bussi

2. *Proposed method to construct Boolean functions with maximum possible annihilator immunity*
   Rajni Goyal

3. *Computational hard problem in periodic monoids and its applications to cryptography*
   Neha Goel

4. *Chromatic number of the line graph associated to a maximal graph*
   Arti Sharma

5. *Cryptanalysis of graphical and chaotic image ciphers*
   Ram Ratan

Day 2: R-5, Satyakam Bhawan
Parallel Session: I (Geometric Function Theory)
Time: 02:00 pm - 05:00pm

1. *Convolution Properties of harmonic Koebe function and its connection with 2-starlike mappings*
   Sumit Nagpal

2. *Schwarzian derivative and Janowski convexity*
Nisha Bohra
3. *On generalized Zalcman conjecture for some classes of analytic functions*
Shelly verma
4. *Janowski Starlikeness and Convexity*
Kanika Khatter
5. *Convexity in one direction of convolution and convex combinations of harmonic functions*
Subzar Beig
6. *Applications of theory of differential subordination for functions with fixed second coeffcient*
Kanika Sharma

Tea Break: 03:30 pm - 03:45 pm

7. Radius constants of analytic functions with certain coefficient inequalities
Sushil Kumar
8. $\mathbb{Z}_p$*-Actions on the product of complex projective space and 3-sphere*
Somorjit K.Singh
9. *Generalised maximal operators between Lebesgue spaces*
Santosh Kaushik
10. Application of functional analysis to abstract differential equations
Muslim Malik
11. *Starlike functions associated with a Lune*
Shweta Gandhi

Day 2: R-4, Satyakam Bhawan
Parallel Session: II (Algebra/Coding/Applied Math.)
Time: 02:00 pm - 04:15 pm

1. *On Jumping Robots Reachability in Graphs*
Dr. Biswajit Deb
2. 2-*path product signed graphs*
Deepakshi Sharma
3. *Continuous character group of a convergence group*
Pranav Sharma
4. *Higher order cone convexity and its generalizations in fractional multiobjective Optimization Problem*
Muskan Kapoor

5. *On Walsh spectrum of cryptographic Boolean function*
   Shashi Kant Pandey

6. *On 2-absorbing Submodules over Commutative Rings*
   Pakhi Aggarwal

Tea Break: 03:30 pm - 03:45 pm

7. *A generalisation of the robes circular restricted problem*
   Bhavneet Kaur

8. *Classifying orbits in the circular restricted three-body problem: A copenhagen case* Vinay Kumar

Day 2: R-2, Satyakam Bhawan
Parallel Session: III (Optimization/Applied Math.)
Time: 02:00 pm - 03:30 pm

1. *Complete scalarizations for a unified vector optimization problem*
   Khushboo

2. *Continuity of efficient and weak efficient solution set maps in set optimization*
   Karuna

3. *S-box analysis in lightweight block ciphers*
   Arvind

4. *The Laguerre wavelet transform on the space* $L^p_{\omega(\alpha)}$
   Meenu Devi

5. *Heat transfer in the axisymmetric steady ow of a non-newtonian second-order uid between two enclosed discs rotating with the different angular velocities subjected to uniform suction and injection*
   Sanjay Kumar

6. *The Stability of a sum form functional equation emerging in information theory*
   Shveta Grover

Abstracts

Some Research Contributions of Prof. B. K. Dass

Poonam Garg and Surbhi Madan

Analyzing Functional Connectivity Patterns of the Brain

G. Rangarajan

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Detecting connectivity patterns in a network of nodes/processes is crucial to the subsequent analysis of the network structure. Once these connectivity patterns are detected, there is also tremendous interest in determining how these patterns change with time. This is important since changes in connectivity patterns can serve as functional biomarkers for the onset of diseases or can be used to detect changes in the underlying states. Granger causality (first proposed by the Nobel Prize winning economist Clive Granger) is a tool that can be used to detect and quantify connectivity patterns. We propose extensions of Granger causality that enable it to be applied to a much wider variety of complex systems. We also demonstrate how changes in connectivity patterns can be measured using these extensions. If time permits, we will consider block coherence, a new tool that we have proposed to study connectivity patterns.

Continued fraction expansions for complex numbers

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Continued fractions expansions of real numbers have played an important role in Number theory, and through it in a variety of areas of mathematics, since they arrived on the scene in the mid-eighteenth century. For complex numbers an analogous study was initiated by Adolf Hurwitz, in a paper published in 1887, but it remained dormant for a long period. We shall introduce the notion and the intricacies involved in the case of complex numbers, and discuss some recent results on the topic.

Some Cryptosystems

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To be announced...

Enumeration formulae for complementary-dual cyclic additive codes

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Let $\mathbb{F}_q$ denote the finite field of order q and characteristic p, n be a positive integer coprime to q and $t \geq 2$ be an integer. A cyclic additive code $\mathcal{C}$ of length n is defined as an $\mathbb{F}_q$-linear subspace of $\mathbb{F}_{q^t}^n$ satisfying the following property: $(c_0, c_1, c_2, \ldots, c_{n-1}) \in \mathcal{C}$ implies that $(c_0, c_1, c_2, \ldots, c_{n-2}) \in \mathcal{C}$. These codes form an important class of error-correcting codes due to their rich algebraic structure and have nice connections with quantum stabilizer codes. Many authors studied their dual codes with respect to the ordinary and Hermitian trace inner products on $\mathbb{F}_{q^t}^n$.

Quadratic residue codes over the ring $\mathbb{F}_p[u]/\langle u^m - u\rangle$ and their Gray images

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Let $m \geq 2$ be any natural number and let $\mathcal{R} = \mathbb{F}_p + u\mathbb{F}_p + u^2\mathbb{F}_p + \cdots + u^{m-1}\mathbb{F}_p$ be a finite non-chain ring, where $u^m = u$ and p is a prime congruent to 1 modulo $(m-1)$. In this talk we explore quadratic residue codes over the ring $\mathcal{R}$ and their extensions. A gray map from $\mathcal{R}$ to $\mathbb{F}_p^m$ is defined which preserves self duality of linear codes. As a consequence self dual, formally self dual and self orthogonal codes are constructed. To illustrate this several examples of self-dual, self orthogonal and formally self-dual codes are given. Among others a [9,3,6] linear code over $\mathbb{F}_7$ is constructed which is self-orthogonal as well as nearly MDS. The best known linear code with these parameters (ref. Magma) is not self orthogonal.

Cayley-Hamilton Theorem for Mixed Discriminants

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We first trace the history of various proofs of the Cayley-Hamilton Theorem. Straubing gave a graph-theoretic proof of the Theorem, which was presented in a more readable exposition by Zeilberger. We outline the main ideas in that proof. We then illustrate an extension to mixed discriminant, which is a generalization of the determinant to an n-tuple of n by n matrices.

Wavelets and Applications

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Delhi 110 025, India.

To be announced…

Spectral behavior of some special matrices

Tanvi Jain

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New Delhi 110 016, India.

Some special matrices related to the Hilbert and Cauchy matrices depict an intriguing spectral behavior. We shall investigate this behavior. In particular, we shall focus on the numbers of positive, negative and zero eigenvalues of these matrices.

Polynomial Systems and Projective Reed-Muller Codes

Sudhir R. Ghorpade

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A univariate polynomial of degree d with coefficient in a field $\mathbb{F}$ has at most d zeros in $\mathbb{F}$. Likewise, a bivariate homogeneous polynomial of degree d over $\mathbb{F}$ has at most d non-proportional zeros in $\mathbb{F}^2 \setminus \{(0,0)\}$ or in other words, at most d zeros in the projective space $\mathbb{P}^1(\mathbb{F})$. However, multivariate polynomials will, in general, have infinitely many zeros. But when $\mathbb{F}$ is the finite field $\mathbb{F}_q$ with q elements, it makes sense to ask for similar degree-based bounds on the number of zeros of one or more multivariate polynomials of given degrees. We consider in particular, the following question. Let r, d, m be positive integers and let $S := \mathbb{F}_q[x_0, x_1, \ldots, x_m]$ denote the ring of polynomials in $m+1$ variables with coefficients in $\mathbb{F}_q$ and $\mathbb{P}^m = \mathbb{P}^m(\mathbb{F}_q)$ the m-dimensional projective space over $\mathbb{F}_q$.

Question: What is the maximum number, say $e_r(d,m)$, of common zeros that a system of r linearly independent homogeneous polynomials of degree d in S can have in $\mathbb{P}^m(\mathbb{F}_q)$?

This question is intimately related to the determination of the generalized Hamming weights of projective Reed-Muller codes. Indeed, when $d \leq q$, we have

$$e_r(d,m) = p_m - d_r(\mathrm{PRM}_q(d,m)),$$

where $p_m = q^m + q^{m-1} + \cdots + q + 1$ is the number of points of $\mathbb{P}^m(\mathbb{F}_q)$ and $\mathrm{PRM}_q(d,m)$ denotes the projective Reed-Muller code of order d and length p_m.

A remarkable conjecture by Tsfasman and Boguslavsky made about two decades ago predicted an explicit and rather complicated formula for $e_r(d,m)$ at least when $d < q-1$. This was already known to be valid in the case $r = 1$, thanks to the results of Serre (1991) as well as Sørensen (1991), The conjectured formula for $e_r(d,m)$ was shown to be true in the case $r = 2$ by Boguslavsky (1997). In this talk, we will outline these developments and report on a recent progress in a joint work with Mrinmoy Datta where we show that the Tsfasman-Boguslavsky Conjecture holds in the affirmative if $r \leq m+1$ and is false in general if $r > m+1$. We will also mention some newer conjectures and results that are partly obtained in collaboration with Peter Beelen and Mrinmoy Datta. These results complement the classical results of Heijnen and Pellikaan (1998) on the generalized Hamming weights of q-ary Reed-Muller codes.

Recent Trends in Internet Technologies in Mathematics Education: Some Practical Experiences and Lessons Learnt

Om Ahuja

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The modern day web-based education or e-learning environment can be divided into two categories: synchronous and asynchronous. The first kind of learning tool is real-time. It is like a virtual classroom which allows students to ask, and teachers to answer questions instantly, through instant messaging, which is why it is called synchronous. In this method, instructors can use learning gateways, hyperlinked pages, screen cam tutorials, streaming audio/video, and live Web broadcasts. Asynchronous web-based education or e-learning can be carried out even while the student is offline. Asynchronous learning involves coursework delivered via web, email and message boards that are then posted on online forums. In such cases, students ideally complete the course at their own pace, by using the internet merely as a support tool rather than volunteering exclusively for an e-learning software or online interactive classes. So, this type of learning is anywhere and any-time instruction delivered over the Internet to browser-equipped learners.

This talk addresses how many of the universities in North America and, in particular, Kent State University is in the process of integrating Internet technologies into its conventional and distance learning programs in higher education. In particular, this talk focuses on the use of internet technologies in teaching face-to-face, blended and fully web-based undergraduate mathematics courses.

Dynamic Model of Online Social Network using Signed Graphs

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In this paper we generalize the existing iterated local transitivity (ILT) model for online social networks for signed networks. In this model, at each time-step t and for every existing vertex x, a new vertex (clone) x' which joins to the neighbours of x is added. The sign of edge xx' is defined by calculating the number of positive and negative neighbours of x. We also discuss the properties such as balance, clusterability, sign-compatibility and consistency of ILT model. The signed networks focus on the type of relations (friendship and enmity) between the vertices (members of online social network). The ILT model for signed graphs gives an insight on how the network reacts to the addition of clone vertex. Also the properties like balance and clusterability help to establish a natural balance in society by providing a possible formation of group of vertices in society for a peaceful co-existence and smooth functioning of social system.

On 2-absorbing Submodules over Commutative Rings

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In this paper, we study the concepts of 2-absorbing submodules and weakly 2-absorbing submodules over commutative ring with non-zero identity which are generalizations of prime submodules. Further, we characterized 2-absorbing submodules with flat submodules. We deeply investigate the concept of 2-absorbing submodules and characterizing it in terms of pure submodules, irreducible submodules and so on. Reformulation of the 2-absorbing avoidance theorem for nitely generated submodule of an R-module has also been done. It is proved that if $N = \langle m_1, m_2, \ldots, m_r\rangle$ be a finitely generated submodule of an R-module M and $N_1, N_2, \ldots, N_n$ be 2-absorbing submodules of an R-module M such that atmost two of $N_1, N_2, \ldots, N_n$ are not 2-absorbing and $(N_i : M) \nsubseteq (N_j : m)$ where $m \in M \setminus N_j$ and $i \neq j$. If $N \nsubseteq N_i$ for each $i, 1 \leq i \leq n$, then there exist $b_2, b_3, \ldots, b_r \in R$ such that $c = m_1 + b_2m_2 + b_3m_3 + \cdots + b_rm_r \notin \cup_{i=n}^{n} N_i$. Later in the paper, the relation between 2-absorbing submodule N and flat module F has been established, that is, if F be a faithfully flate R-module, then N is a 2-absorbing submodule of M if and only if $F \otimes N$ is a 2-absorbing submodule of $F \otimes M$.

On Jumping Robots Reachability in Graphs

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Given two vertices u, v in a graph G, by C_u^v we denote the configuration of G with a robot at vertex u, a hole at vertex v and obstacles at the remaining vertices of G. A graph G is said to be complete S-reachable if starting from each configurations in G the robot can be taken to any other vertex of G by a sequence of moves consisting of simple moves of the obstacles and mRJ moves of the robot for m 2 S, where S is a finite non-empty set of non-negative integers. An mRJ move on Cu v is the process of moving the robot from u to v by jumping over m obstacles if there is a u-v path of length m + 1 in G. A 0RJ move is known as a simple move. There are two possible research directions in this problem:

A. characterization of complete S-reachable graphs.

B. finding minimum number of moves to take a robot from the source to the destination.

In this article our focus is on the problem A. The complete $\{0, m\}$-reachability problem is also known as the complete mRJ-reachability problem on graphs. In [3] the complete $2RJ$ and $3RJ$ reachable trees are characterized. The complete S-reachability problem introduced in [6] is a natural generalization of a similar reachability problem introduced in [4] and it was shown that a graph G is complete $\{0\}$-reachable if and only if G is biconnected. In [2] a necessary and sufficient condition for a bi-connected graph to be a complete $\{m\}$-reachable is discussed.

In this article, we present two classes of trees $\mathbb{T}_{4.1}$ and $\mathbb{T}_{4.2}$ that are minimal complete $\{0, 4\}$-reachable. We also conjecture the following:

Conjecture 1. If T is a minimal complete $\{0, 4\}$-reachable tree then T belongs to either the class $\mathbb{T}_{4.1}$ or to the class $\mathbb{T}_{4.2}$.

Conjecture 2. If T is a complete $\{0, 4\}$-reachable tree then T contains a tree as a subtree either from the class $\mathbb{T}_{4.1}$ or from the class $\mathbb{T}_{4.2}$.

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Proposed method to construct Boolean functions with maximum possible annihilator immunity

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There are many attack in cryptosystem like algebraic attack, linear crypt- analysis, differential cryptanalysis, correlation attack etc. To resist the cipher system from the attacks Boolean functions should have good combination of cryptographic properties such as balancedness, nonlinearity, resiliency, autocorrelation etc. Optimum value of Algebraic Immunity is required to resist fast algebraic attack but Algebraic (annihila- tor) immunity alone does not provide sufficient resistance against algebraic attacks. If f is some given Boolean function, to obtained the minimum degree annihilators of f, $1 + f$ is not enough and one should check the relationships of the form $fg = h$, and a function f, even if it has very good algebraic immunity, is not necessarily good against fast algebraic attack, if degree of g becomes very low when degree of h is equal to or little greater than the algebraic immunity of f. In this paper, we have developed a multi-objective evolutionary approach based on NSGA-II and we got the optimum value of annihilator immunity from this point of view. We have constructed balanced Boolean functions having the best trade-off among balancedness, Annihilator immunity, autocorrelation and nonlinearity for 6 and 7 variables by the proposed method.

Chromatic number of the Line Graph associated to a Maximal Graph

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Let R be a commutative ring with identity. Let $\Gamma(R)$ denote the maximal graph associated to R, that is, $\Gamma(R)$ is a graph with vertices as non-units of R, where two distinct vertices a and b are adjacent if and only if there is a maximal ideal of R containing both. In this talk we discuss chromatic index of $\Gamma(R)$ and chromatic number of line graph of $\Gamma(R)$, denoted by $L(\Gamma(R))$. For any ring R, we have shown that $\chi(L(\Gamma(R))) = clique(L(\Gamma(R)))$.

2-path product signed graphs

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A signed graph $\sum = (V, E, \sigma)$ is a graph $G = (V, E)$ where $\sigma : E \to \{+, -\}$. These graphs are mainly used in social sciences where graph represents relation, individuals as vertices and relation between them as edges. In signed graphs we define these relations(edges) as of friendship (or '+' edge) or enmity (or '-' edge). A *2-path product signed graph* $(\sum)_{2^*} = (V, E', \sigma')$ of a signed graph $\sum = (V, E, \sigma)$ is defined as follows: the vertex set is same as the original signed graph $\sum$ and two vertices $u, v \in V((\sum)_{2^*})$, are adjacent if and only if there exist a path of length two in $\sum$. The sign of an edge uv is the product of marks of vertices u and v in $\sum$. The mark of vertex u in $\sum$ is the product of signs of all edges incident to the vertex. In this paper we give a characterization of 2-path product signed graphs. Also some other properties of 2-path product signed graphs are discussed.

Continuous character group of a convergence group

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Cartesian closedness play an important role in functional analysis, and this is why functional analysts often prefer to work with convergence spaces instead of topological spaces. An extension of the Pontryagin duality theory from the topological abelian groups to the class of convergence abelian groups is the continuous duality theory. By analysing the suitable structures (limit related structures) on the continuous character group of a convergence abelian group we present the facts obtained while investigating the duality properties in a class of convergence groups.

S-box Analysis in Lightweight Block Ciphers

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With the advancement in technologies, the electronic gadgets are becoming smaller day by day and researchers and developers are discussing about resource constrained small hardware devices. Whether it is Smart cards, RFID tags or Internet of Things (IoT), everywhere security of data is very crucial. An urgent need was felt to use cryptographic primitives in these devices without compromising the security and as a result various lightweight ciphers have been designed for last several years. In this paper, we discuss several lightweight block ciphers and also present comparative analysis of s-boxes used in them. Differential cryptanalysis and linear cryptanalysis are two most popular cryptanalytic attacks on block ciphers. Therefore keeping these two attacks in mind, each characteristic has been described.

Certain Characterizations of Orthogonal Gabor Systems on Local Fields

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Gabor systems are collections of functions which are built by the action of modulations and translations of a single function, and hence, can be viewed as the set of time-frequency shifts of $\psi \in L^2(\mathbb{R})$ along the lattice $a\mathbb{Z} \times b\mathbb{Z}$ in $\mathbb{R}^2$. These systems were introduced by Gabor [1] with the aim of constructing efficient, time-frequency localized expansions of signals. These systems are also known as Weyl-Heisenberg systems. A general procedure for constructing Gabor systems on local fields of positive characteristic was considered by Li and Jiang [2] using basic concepts of operator theory and Fourier transforms. One of the fundamental problems in the study of Gabor systems is to find conditions on the generator function and the modulation and translation parameters so that the corresponding Gabor system is orthogonal. The present paper is devoted to a discussion of this theme in the context of local fields of positive characteristic. We provide complete characterizations of orthogonal families, tight frames and orthonormal bases of Gabor systems on local fields of positive characteristic by means of some basic equations in the Fourier domain.

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An Extension Of Uncertainty Principle to Generalized Wavelet Transform

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The Uncertainty Principle, which is a fundamental feature of Quantum mechanical systems, forms a mathematical point of view can be considered as a “meta-theorem” in harmonic analysis, which can be summed up as: a non-zero function and its Fourier transform cannot be sharply localized. Now a days, there are many versions of Uncertainty principle[1,2,3,4,5,6]. Keeping in mind the boundaries and limits of classical Fourier transform, one cannot expect to achieve a perfect phase resolution. Usually we can expect time frequency resolution of a Generalized Wavelet Transform(GWT) with the frequency resolution of an affine mother wavelet. In this paper, we analyze the GWT as a function on two dimensional space which gives rise to a different class of uncertainty principle as compared to the localization of f and $\hat{f}$ of its wavelet transform.

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Some ideal convergent multiplier sequence spaces using de la Valleee Poussin mean and Zweier operator

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The main object of this paper is to introduce multiplier type ideal convergent sequence spaces using Zweier transform and da la Vallee Poussin mean. We study some of their topological and algebraic properties on these spaces.Further we prove some inclusion relations related to these new spaces.

The Laguerre Wavelet Transform on the Space $L^p_{\omega(\alpha)}$

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In the present paper we consider a set of weighted Lebesgue spaces $L^p_{\omega(\alpha)}, 1 \leq p \leq \infty$, which appear to the suitable for the Laguerre convolution in several respects [3].

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On B^*-Continuous Multifunctions and its Selection in B^*-Cluster System

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There are many generalizations of the notion of continuity like quasi-continuity, B-continuity, B*-continuity etc. These generalizations exist for multifunctions as well. The real challenge is to prove the existence of continuous selections for these generalized continuous multifunctions. It has been shown by many mathematicians that continuous selections exist for multifunctions defined on special type of topological spaces. It is also observed that continuous selection does not always exist but we can find quasi-continuous selection for generalized continuous multifunctions. Here the notion of B*-cluster system related to B*-sets and B*-continuous multifunctions is introduced and some important results on lower and upper B*-cluster continuous multifunctions and their selection in this cluster system is established.

On generalized Zalcman conjecture for some classes of analytic functions

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For functions $f(z) = z + a_2z^2 + a_3z^3 + \cdots$ in various subclasses of normalized analytic functions, we consider the problem of estimating the generalized Zalcman coefficient functional $\phi(f, n, m; \lambda) := |\lambda a_n a_m - a_{n+m-1}|$. For all real parameters λ and $0 \leq \beta < 1$, we provide the sharp upper bound of $\phi(f, n, m; \lambda)$ for functions satisfying $\operatorname{Re} f'(z) > \beta$ and hence settles the open problem of estimating $\phi(f, n, m; \lambda)$ recently proposed by Agrawal and Sahoo [S. Agrawal and S. K. Sahoo, On coefficient functionals associated with the Zalcman conjecture, arXive preprint,2016]. It is worth mentioning that our technique provides the sharp estimation of $\phi(f, n, m; \lambda)$ for starlike and convex functions of order α $(\alpha < 1)$ when $\lambda < 0$. Moreover, for certain positive λ, the sharp estimation of $\phi(f, n, m; \lambda)$ is given when f is a typically real function or a univalent function with real coefficients or is in some subclass of close-to-convex function.

A Generalisation of the Robe's Circular Restricted Problem

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The aim of this paper is to investigate the Robe's restricted problem of 2+2 bodies for two cases: with a Roche ellipsoid-triaxial system and with a Roche ellipsoid-oblate system. Without ignoring any component in any problems, a full treatment is given of the buoyancy force. We take the shape of the first primary of mass m_1 a Roche ellipsoid and the second primary of mass m_2 a triaxial or an oblate spheroid. The third and the fourth bodies (of mass m_3 and m_4 respectively) are small solid spheres of density ρ_3 and ρ_4 respectively inside the ellipsoid, with the assumption that the mass and the radius of the third and the fourth body are infinitesimal. We assume that m_2 is describing a circle around m_1. The masses m_3 and m_4 mutually attract each other, do not influence the motion of m_1 and m_2 but are influenced by them. We have taken into consideration all the three components of the pressure field in deriving the expression for the buoyancy force viz (i) due to the own gravitational field of the fluid (ii) that originating in the attraction of m_2 (iii) that arising from the centrifugal force. The relevant equations of motion are established and the linear stability of the equilibrium solutions are examined.

Janowski Starlikeness and Convexity

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Certain necessary and sufficient conditions are determined for the functions f of the form $f(z) = z - \sum_{n=2}^{\infty} a_n z^n$, $a_n > 0$, to belong to various subclasses of starlike and convex functions. Also discussed are certain sufficient conditions for the normalised analytic functions f of the form

$$\left(\frac{z}{f(z)}\right)^{\mu} = 1 + \sum_{n=1}^{\infty} b_n z^n, \quad \mu \in \mathbb{C}$$

to belong to the class of Janowski starlike functions.

Convexity in one direction of convolution and convex combinations of harmonic functions

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We show that the convolution of the harmonic function $f = h + \bar{g}$, where $h(z) + e^{-2i\gamma} g(z) = z/(1 - e^{i\gamma} z)$ having analytic dilatation $e^{i\theta} z^n (0 \leq \theta < 2\pi)$, with the mapping $f_{a,\alpha} = h_{a,\alpha} + \overline{g}_{a,\alpha}$, where $h_{a,\alpha}(z) = (z/(1+a) - e^{i\alpha} z^2/2)/(1 - e^{i\alpha} z)^2$, $g_{a,\alpha}(z) = (a e^{2i\alpha} z/(1+a) - e^{3i\alpha} z^2/2)/(1 - e^{i\alpha} z)^2$ is convex in the direction $-(\alpha + \gamma)$. We also show that the convolution of $f_{a,\alpha}$ with the right half-plane mapping having dilatation $(a - z^2)/(1 - a z^2)$ is convex in the direction $-\alpha$. Finally, we introduce a family of univalent harmonic mappings and find out sufficient conditions for convexity along imaginary-axis of the linear combinations of harmonic functions of this family.

Applications of theory of differential subordination for functions with fixed second coefficient

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Open door lemma is proved for the analytic function f in the unit disc with fixed second coefficient. Conditions on f are obtained so that $\alpha-$ convex integral operator on f belong to certain subclasses of starlike functions. Several interesting applications are given.

Starlike functions associated with a Lune

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Recall that an analytic function f is subordinate to an analytic function g, written as $f \prec g$, if there is an analytic function $w : \mathbb{D} \to \mathbb{D}$ with $w(0) = 0$ such that $f(z) = g(w(z))$ for all $z \in \mathbb{D}$. Several subclasses of starlike functions are associated with regions in the right half plane of the complex plane, like half-plane, disks, sectors, parabolas and lemniscate of Bernoulli. For a normalized analytic function f defined on the open unit disk $\mathbb{D}$ belonging to certain well known classes of functions associated with the above regions, we investigate the radius ρ such that, for the function $F(z) = f(\rho z)/\rho$, $zF'(z)/F(z)$ lies in the lune defined by $\{w \in \mathbb{C} : |w^2 - 1| < 2|w|\}$ for all $z \in \mathbb{D}$. Recently, Raina and Sokol considered the subclass of starlike functions f such that $zf'(z)/f(z)$ is subordinate to $z + \sqrt{1+z^2}$. In this paper, we have also generalized various sufficient conditions for a function to be in this class.

Perturbation of Frames in Locally Convex Spaces

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In this paper, we present some Paley-Wiener type perturbation results for frames in a real(or complex) sequentially complete locally convex separable topological vector space, where the topology τ of $\mathcal{A}$ is considered to be Hausdorff.

We investigated that if a locally convex space $\mathcal{A}$ has a frame $\{x_n\}$, then whether any sequence $\{y_n\}$ is a frame for $\mathcal{A}$, provided $\{y_n\}$ is chosen "sufficiently nearer" to $\{x_n\}$ in a suitable sense. We have obtained various sufficient conditions for this sequence $\{y_n\}$ to become a frame, with various different nearness conditions. Finally we proved a necessary condition for the perturbed sequence to be a frame, in terms of an eigenvalue of a matrix associated with the perturbed sequence.

Schwarzian derivative and Janowski convexity

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Let $\mathcal{A}$ be the class of functions f analytic in the open unit disk $\mathbb{D} = \{z \in \mathbb{C} : |z| < 1\}$ and normalized by the conditions $f(0) = 0$, $f'(0) = 1$. For locally univalent functions $f \in \mathcal{A}$, the Schwarzian derivative of f is defined as

$$S_f(z) = \left(\frac{f''(z)}{f'(z)}\right)' - \frac{1}{2}\left(\frac{f''(z)}{f'(z)}\right)^2.$$

Several necessary and several sufficient conditions have been proved by various authors relating the Schwarzian derivative to the univalency of a function $f \in \mathcal{A}$. Later Miller and Mocanu determine the sufficient conditions for starlikeness and convexity of f in terms of Schwarzian derivative, using the theory of differential subordination. Let $K[A, B]$ denote the class of Janowski convex functions. Here, in this paper, we prove that

$$\operatorname{Re}\Phi\left(1 + \frac{zf''(z)}{f'(z)}, z^2 S_f(z)\right) > 0 \quad \text{implies} \quad f \in K[A, B],$$

where $\Phi : \mathbb{C}^2 \to \mathbb{C}$ is a function satisfying certain conditions. As a corollary, we obtain

$$\operatorname{Re}\left((A + B)\left(\frac{zf''(z)}{f'(z)}\right)^2 + 2(A - B)z^2 S_f(z)\right) > 0 \quad \text{implies} \quad f \in K[A, B]$$

and also,

$$\mathrm{Re}\left(2(A-B)z^2S_f(z)-(A+B)\left(\mathrm{Im}\left(1+\frac{zf''(z)}{f'(z)}\right)\right)^2\right)>0 \quad \text{implies} \quad f\in K[A,B].$$

Also, some equivalent sharp inequalities are proved for f to be Janowski convex.

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z-Perfectly Continuous Functions

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A new class of functions called z-perfectly continuous functions is introduced ,which properly includes the class of pseudo perfectly continuous functions but turns out to be independent of continuity. Along with the study of basic properties of z-perfectly continuous functions, the interplay between topological properties and z-perfectly continuous functions is also investigated.

Weyl Theory for Bounded and Unbounded Operators - A Comparative Study

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The theory of operators is a branch of mathematics that focuses on bounded linear operators but which includes closed operators and unbounded operators. The subject of operator theory and its most important part, *the spectral theory*, came into focus rapidly after 1900. A major event was the appearance of *Fredholm's theory of integral equations*, which arose as a new approach to the Dirichlet problem.

In 1909, H. Weyl (*Über beschränkte quadatische Formen, deren Differenz Vollstetig ist*, Rend. Circ. Mat. Palermo, 27 (1909), p. 373-392) examined the spectra of all compact perturbations of a self adjoint operator on a Hilbert space and found that their intersection consisted precisely of those points of the spectrum which were not isolated eigenvalues of finite multiplicity. A bounded linear operator satisfying this property is said to satisfy **Weyl's theorem**.

Further, in 2002, M. Berkani (*Index of B-Fredholm operators and generalization of a Weyl's theorem*, Proc. Amer. Math. Soc., 130 (2002), p. 1717-1723) proved that if T is a bounded normal operator acting on a Hilbert space H, then σ_{BW}(T) = σ(T) \E(T), where E(T) is the set of all isolated eigenvalues of T, which gives the generalization of the Weyl's theorem. He also proved this generalized version

of classical Weyl's theorem for bounded hyponormal operators (*Generalized Weyl's theorem and hyponormal operators*, J. Aust. Math. Soc., 76(2) (2004) 291–302).

Following Weyl and Berkani, various variants of Weyl's theorem, generally known as the Weyl-type theorems, have been introduced with much attention to an approximate point version called a-Weyl's theorem. Study of other generalizations began in 2003 that resulted in the Browder's theorem, a-Browder's theorem, generalized a-Weyl's theorem, property (w), property(b), etc. This study, however, was limited to the classes of bounded operators.

Our objective was to study non-normal classes of unbounded operators on a Hilbert space and various Weyl-type theorems for those classes of operators. Some of the classes studied include the class of normal operators and hyponormal operators. Also we have introduced and studied Weyl-type theorems for the class-$\mathcal{A}$ operators. We have proved the following results:

"If T is an unbounded normal operator, then

(i) λ is an isolated point of $\sigma(T)$ if and only if λ is a simple pole of the resolvent of T.

(ii) all the variants of Weyl's Theorem are equivalent, and

(iii)T satisfies all these variants."

"If T is an unbounded hyponormal operator or an unbounded class-$\mathcal{A}$ operator, then

(i) p(T - λI) $\leqslant 1$ for every $\lambda \in \mathbb{C}$,

(ii) λ is an isolated point of $\sigma(T)$ if and only if λ is a simple pole of the resolvent of T.

(iii) σ(T) = σ_w(T) $\cup$ isoσ_o(T) = σ_w(T) $\cup$ π_o(T), where isoσ_o(T) is the set of all isolated spectral points of finite multiplicity and π_o(T) is the set of poles of finite multiplicity.

(iv) σ(T) = σ_{BW}(T) $\cup$ isoσ(T) = σ_{BW}(T) $\cup$ π(T)."

In the case of hyponormal operators and class-$\mathcal{A}$ operators, as a consequence of the results proved, the following equivalences between several variants were established:

"If T is an unbounded hyponormal operator or an unbounded class-$\mathcal{A}$ operator, then

(i) property (w) is equivalent to property (b),

(ii) Weyl's Theorem is equivalent to Browder's Theorem

(iii) generalized Weyl's Theorem is equivalent to generalized Browder's Theorem

(iv) property (gw) is equivalent property (gb)."

$\mathbb{Z}_p$-Actions on the Product of Complex Projective Space and 3-Sphere

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Let $G = \mathbb{Z}_p$, p an odd prime, act freely on a finitistic space$X$ with mod p cohomology ring isomorphic to that of $\mathbb{C}P^m \times \mathbb{S}^3$, where$m + 16 \not\equiv 0 \mod p$. We wish to discuss the existence and nonexistence of G-equivariant maps $\mathbb{S}^{2q-1} \to X$ and $X \to \mathbb{S}^{2q-1}$, where $\mathbb{S}^{2q-1}$ is equipped with a free G-action. These results are an analogue of celebrated Borsuk-Ulam theorem. To establish these results first we find the cohomology algebra of free G-actions on X. For a continuous map $f : X \to \mathbb{R}^n$, a lower bound of the cohomological dimension of the partial coincidence set of f is determined.

Radius Constants of Analytic Functions with Certain Coefficient Inequalities

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In this note, the sharp radius estimates for the analytic functions whose Taylor coefficients satisfy some coefficient inequalities are determined. Further, we proved that the classes of such functions are closed under Hadamard product with convex functions.

Generalised Maximal Operators Between Lebesgue Spaces

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We have introduced a new one-sided fractional maximal operator $M^{+}_{g,\alpha}$ between weighted Lebesgue spaces and investigated the characterising conditions under which the new one-sided fractional maximal operator is strongly bounded between weighted Lebesgue spaces (with or without different weights). The weak boundedness of the same operator has also been studied. Many properties of the characterising conditions have been proved.

Continuous Weaving Frames

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Two discrete frames $\{\phi_i\}_{i\in I}$ and $\{\psi_i\}_{i\in I}$ for a separable Hilbert space $\mathbb{H}$ are said to be woven, if there are universal positive constants A and B such that for every subset $\sigma \subset I$, the family $\{\phi_i\}_{i\in\sigma} \cup \{\psi_i\}_{i\in\sigma^c}$ is a frame for $\mathbb{H}$ with lower and upper frame bounds A and B, respectively. Weaving frames are powerful tool in pre-processing signals and distributed data processing. Motivated by the recent work of Bemrose et al. and Casazza and Lynch on weaving frames for separable Hilbert spaces, we study continuous weaving frames for Hilbert spaces with respect to a measure space. In this paper, a necessary and a sufficient condition for continuous weaving frames is given. We provide an estimate of a series associated with the metric operators of continuous weaving frames. It is proved that an invertible operator applied to continuous woven frames leaves them woven.

Convolution Properties of harmonic Koebe function and its connection with 2-starlike mappings

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In 1984, Clunie and Sheil-Small constructed the harmonic Koebe function $K = H + \overline{G}$ expecting it to play the role of extremal function for extremal problems over the class of sense-preserving harmonic univalent functions suitably normalized in the open unit disk. In this paper, we investigate the convolution properties of K. In addition, we discuss the geometric properties of 2-starlike functions defined using the Sălăgean differential operator. Given a 2-starlike function φ, the product $\varphi \tilde{*} K = \varphi * H + \overline{\varphi * G}$ is shown to be univalent and convex in the direction of the real axis.

Application of Functional Analysis to Abstract Differential Equations

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In this manuscript, we shall study a control system represented by an abstract differential equation with deviated argument in a Hilbert space X. We applied the semigroup theory of linear operators and Banach fixed point theorem to study the exact controllability of the system. Also, we studied the exact controllability of the nonlocal control system. Finally, we have given an example to show the application of these results.

Approximation of signals in Lebesgue Spaces

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The theory of summability arises from the process of summation of series and the significance of the concept of summability has been strikingly demonstrated in various contexts e. g. in Analytic Continuation, Quantum Mechanics, Probability Theory, Fourier Analysis, Approximation Theory and Fixed Point Theory. The methods of almost summability and statistical summability have become an active area of research in recent years. This short monograph is the first one to deal exclusively with the study of some summability methods and their interesting applications. We consider here some special regular matrix methods as well as non-matrix methods of summability. Broadly speaking, signals are treated as functions of one variable and images are represented by functions of two variables. Positive approximation processes play an important role in Approximation Theory and appear in a very natural way dealing with approximation of continuous functions, especially one, which requires further qualitative properties such as monotonicity, convexity

and shape preservation and so on. Analysis of signals or time functions is of great importance, because it conveys information or attributes of some phenomenon. The engineers and scientists use properties of Fourier approximation for designing digital filters. In this talk, we discuss the basic tools of approximation theory & determine the error (degree) in approximation of a signal (function) by different types of positive linear operators in various Function spaces like as in L_p-spaces. During this talk, few applications of approximations of functions will also be highlighted.

Heat transfer in the axisymmetric steady flow of a non-newtonian second-order fluid between two enclosed discs rotating with the different angular velocities subjected to uniform suction and injection

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Heat transfer in the axisymmetric steady flow of a second-order incompressible fluid between two enclosed discs rotating with different angular velocities in the same sense subjected to uniform suction and injection is considered. The flow and heat functions are expanded in the ascending powers of flow Reynold's number R_z (assumed small). The effect of second-order dimensionless parameter $\tau_2(\tau_1 = \alpha\tau_2, \alpha = -0.2)$, angular velocity ratio N, suction parameter A on the temperature profile and Nusselt's numbers Nu_a (at lower disc), Nu_b (at upper disc) have been discussed and shown graphically in case of net radial outflow ($R_m = 0.05$) and net radial inflow ($R_m = -0.05$) in the regions of no-recirculation ($\xi = 1$) and recirculation ($\xi = 10$).

Neeva: A Lightweight Hash Functions

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One of the important tasks in front of cryptographers is to preserve the privacy, authentication as well as integrity of the messages which we want to send through insecure channel like internet. Hash functions play a significant role in cryptography. Lightweight cryptography ensures that the algorithm would be efficient and secured (majorly preimage resistant) at the lower cost. Its main aim is to achieve "low cost"

subjected to good efficiency in hardware as well as software. RFID technology is one of the major applications of lightweight cryptography where security and cost both are equally essential or we may say that cost friendly cryptographic tools have given more weightage.

In this paper, we propose a lightweight hash, *Neeva-hash* satisfying the very basic idea of lightweight cryptography. Neeva-hash is based on sponge mode of iteration with software friendly permutation which provides great efficiency and security required in RFID technology. The proposed hash can be used for many application based purposes.

Computational hard problem in periodic monoids and its applications to cryptography

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The concept of asymmetric key was introduced by Diffie-Hellman in 1976. Asymmetric key cryptography plays a significant role in providing authenticity, integrity, privacy and non-repudiation over an open communication channel. A lot of asymmetric key cryptography protocols has been designed to achieve security over an open communication channel. The security of asymmetric key cryptography relies on the intractability of some computational hard problems.

In this paper, we introduce a computational problem in periodic monoids which we will call as Element Search Problem(ESP). In particular case, this problem can be reduce to the Discrete Logarithm Problem with Conjugacy Search Problem(DLCSP) in non-abelian group.

Using ESP, we design a key exchange protocol and a digital signature scheme. We also discuss the complexity of ESP and security of proposed digital signature scheme.

On Walsh spectrum of cryptographic Boolean function

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From Walsh transformation of a Boolean function we can explore its major cryptographic behaviour viz. Bentness, Plateauedness, Non-linearity, Regularity etc. With an optimal non-linearity, bent functions always attracts the cryptographic community. Their construction on different domains and non existence for different parameters enhances the trade-off among all the cryptographic behaviours. In this paper we have proposed a new approach for generalized Boolean function which is based on formulation of Diophantine equations. We have also shown by examples how this approach can be utilised to prove non existence of GBF or to prove regularity of GBF. Formulation of these Diophantine equations confirmed us the regularity of generalized bent functions for $q = 5$ and $n = 2$, which is totally different from the results of Kumar et. al. on generalized bent functions. We hope that this method will help to detect more cases when a GBF is regular or it ceases to exist.

Cryptanalysis of Graphical and Chaotic Image Ciphers

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Encryption of Images is used for multimedia security and various methods of image encryption have been reported in the literature. Cryptanalysis is required for checking the security strength of these methods. In this paper, the cryptanalysis of graphical and chaotic image encryption methods is presented. The pixels are inverted in graphical encryption method and the pixels are circularly rotated in chaotic encryption method randomly in the image plane. In the cryptanalysis of these methods, the neighbourhood similarity characteristics among the pixels is applied to decrypt the encrypted images. The decryption methods, discussed in this paper, are key independent and no knowledge of key is required. The resulting decrypted images obtained for the encrypted images of graphical and chaotic based image encryption methods are quite intelligible and show that these encryption methods are not providing enough security and hence not useful for securing vital images.

Perfect and MDS Poset Block Codes

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Take a metric space (V, d) and consider the problem of covering V with non-overlapping spheres of the same radius. Viewing this sphere-packing problem in the context of coding theory gives rise to 'perfect codes'. With respect to the classical Hamming metric, Hamming and Golay codes are the only classes of non-trivial perfect codes. The class of 'MDS codes' arising from Singleton bound is another optimal class of codes having distinctive mathematical structure and wide applicability. With respect to Hamming metric, the largest known length of an MDS code over $\mathbb{F}_q$ is $q + 2$ where $\mathbb{F}_q$ denotes the finite field with q elements.

We explore perfect and MDS codes with respect to poset block metric, a generalization of Hamming metric. The following problems have been considered:

1. Characterization of 1-perfect and in general, r-perfect poset block codes
2. Introduction of Singleton bound for codes in poset block metric
3. Relation between perfect and MDS poset block codes

In this talk, we review basics of poset block space and present the solutions to the above problems.

Construction of m-repeated Burst Error Detecting and Correcting Non-Binary Linear Codes

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The paper proposes a simple algorithm for constructing a parity-check matrix for any linear code over $GF(q)$ capable of detecting and correcting a new kind of burst error called 'm-repeated burst error of length b or less' recently introduced by the authors. Codes based on the proposed algorithm have been illustrated.

The Stability of a Sum Form Functional Equation Emerging in Information Theory

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The goal of this paper is to investigate the Hyer-Ulam- Rassias stability of a sum form of functional equation containing two unknown real valued functions.

Set optimization using improvement sets

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In this paper we introduce a notion of minimal solutions for set-valued optimization problem, unifying a set criterion notion introduced by Kuroiwa [2] for set-valued problems and a notion introduced by Chicco et al. [1] using improvement sets for vector optimization problems. For these solutions we establish existence and lower convergence in the sense of Painlevé-Kuratowski.

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An Algorithm for Solving the Problem of Industry by Formulating it as a Capacitated Transportation Problem

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This paper presents the solution to the problem of the manager of a trading firm, D.M Chemicals, who deals in the trade of marble powder. The problem of the manager is to determine the quantity (in tons) of marble powder that the firm should purchase from different sellers and sell to the different buyers such that the total cartage and ratio of purchasing cost to profit is minimized provided the demand and supply conditions are satisfied and the extra demand is also met during emergency situations. The problem under consideration is modeled as a linear plus linear fractional capacitated transportation problem with enhanced flow. The data is taken from the account keeping books of the firm. To solve the linear plus linear fractional capacitated transportation problem with enhanced flow (EP), a related transportation problem (RT P) is formed and it is shown that to each corner feasible solution to (RT P),there is a corresponding feasible solution to enhanced flow problem. An optimal solution to (EP) is shown to be determined from an optimal solution to (RT P). The solution so obtained by using the developed algorithm is compared with the existing data. Moreover, the solution obtained is verified by a computing software Excel Solver.

Linear Fractional Bilevel Programming Problem with Multi-choice Parameters

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A bilevel programming problem (BLPP) is a hierarchical optimization problem where the constraint region of the upper level is implicitly determined by the lower level optimization problem. In this paper, a bilevel programming problem is considered in which the objective functions are linear fractional programming problems and the feasible region is a convex polyhedron. In this (BLPP), the cost coefficient of the objective functions are multichoice parameters. Here, multi-choice parameters are replaced using interpolating polynomials. Then, fuzzy programming is used to find the compromise solution of the transformed (BLPP). An algorithm is developed to find the compromise solution of (BLPP). The method is illustrated with the help of an example.

Higher Order Cone Convexity and its Generalizations in Fractional Multiobjective Optimization Problem

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In this paper, sufficient optimality conditions are established for a feasible point to be weak minimum, minimum or strong minimum using higher order cone convex functions for a fractional multiobjective optimization problem over arbitrary cones in which the denominator of each component of the objective function contains the same scalar function. Duality results are established for a higher order Schaible type dual program using higher order cone convex and other related functions.

Classifying Orbits in the Circular Restricted Three-Body Problem: A Copenhagen Case

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In the present article, we have numerically investigated the nature of motion in the Copenhagen case of the Circular Restricted Three-Body Problem (CRTBP). CRTBP is most simple form of nonlinear dynamical model in the field of Celestial Mechanics. We have proposed the method of time-frequency analysis (TFA) based on the wavelet transform for the investigation. TFA based on the wavelet transform generates time-frequency landscape, known as ridge-plot. By Ridge-plot, we classify the regular and chaotic trajectories in this nonlinear dynamical model. Numerical experiments suggest that the computational time of this ridge-plot is almost negligible as compared to other chaos indicators (such as Lyapunov Characteristic Exponent (LCE), Smaller Alignment Index Method (SALI), etc.). This method requires less computational effort, and it is readily applicable to higher dimensional dynamical systems. Sometimes, to know whether a given trajectory is chaotic it is desirable to know when, where and to what degree an orbit is chaotic. Also, the computation and visualization of the resonance trapping of a chaotic trajectory is also an important aspect of the phase space structure. With the help of ridge-plots, we have explained the phenomenon of resonance trapping. Additionally, the difference between periodic and quasi-periodic, sticky and nonsticky trajectories are presented using ridge-plots. We have also used the method of Poincare surfaces of section as a supporting tool for getting several initial conditions and the idea about regular and chaotic regions of the phase space of this model.

KT-pseudoinvex Interval Valued Optimization Problem

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In the present paper KT-pseudoinvexity conditions are proposed for interval valued optimization problems and this problem is termed as KT-pseudoinvex interval valued optimization problem. This problem is charcaterized in such a way that all Kuhn-Tucker point are LU-optimal solutions. Mond-Weir Dual is proposed, for which weak and strong duality results are established.

Complete scalarizations for a unified vector optimization problem

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This paper aims to characterize minimal and approximate minimal solutions of a unified vector optimization problem via scalarizations, which are based on general order representing and order preserving properties. Additionally, we show that an existing nonlinear scalariation, using Gerstwitz function, is a particular case of the proposed scalarization.

Continuity of efficient and weak efficient solution set maps in set optimization

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In this paper, we investigate the upper and the lower semicontinuity of efficient and weak efficient solution set maps for a parametric set optimization problem. The upper semicontinuity of weak efficient solution set map is established under certain continuity and compactness assumptions. In addition, strict quasiconvexity of objective map is used to establish the upper semicontinuity of efficient solution set map and the lower semicontinuity of both weak efficient and efficient solution set maps.

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