INDIAN MATHEMATICAL SOCIETY

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NEWSLETTER

NO. 33

March/April

2015

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Facsimile of the Commemorative Postage Stamp on the 'Indian Mathematical Society' issued by the Department of Posts (Philately Division, Government of India, to mark the completion of hundred years of the Society. Released on the Inaugural day of the Platinum Jubilee 75th Annual Conference of the Society on 27th December 2009.

Contents

IMS Newsletter

March/April 2015

Important Events

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1. Ensuing 81^{st} **Annual Conference** of the Society The ensuing 81st Annual Conference of the Society will be held under the auspices of Visvesvaraya National Institute of Technology (VNIT), Nagpur, Maharashtra during December 27-30, 2015. Prof. G. P. Singh, Professor of Mathematics and Dean (Students Welfare), VNIT will be the Local Organizing Secretary. His E-mail id is gpsingh@mth.vnit.ac.in.

2. **Prof. A. M. Mathai**, Pala, Kerala has been elected as the **President of the Society** for a period of one year with effect from **April 1, 2015**.

3. **Dr. P. B. Vinod Kumar** (Rajagiri School of Engineering and Technology, Cochin), **Prof. Manjusha Muzumdar** (Calcutta University, Kolkata) and **Dr. Bankteshwar Tiwari** (BHU, Varanasi) have been elected as **members of the Council** for a period of three years with effect from **April 1, 2015**.

4. **Prof. Manjul Bhargava** (Indian origin), Princeton University, USA has been awarded **Fields Medal** 2014 by the International Mathematical Union at the International Congress of Mathematicians 2014 held during August 13-21, 2014 at Seoul, South Korea for his work on Number Theory.

5. **Prof. Subhash Khot** (Indian origin), Courant Institute of Mathematical Sciences, New York University, USA has been awarded the **Rolf Nevanlinna Prize** by IMU for his prescient definition of the unique games problem and its consequences in the study of optimization problems at the ICM 2014.

6. The Norwegian Academy of Sciences and Letters has decided to award the **Abel Prize** for 2015 to the American mathematicians **John F. Nash, Jr. and Louis Nirenberg** for striking and seminal contributions to "the theory of nonlinear partial differential equations and its applications to geometric analysis.

7. The 4-year **Asian Mathematical Conference (AMC)** will be held in **Bali, Indonesia** during July 25-28, 2016. The members of IMS are encouraged to participate in this conference.

80^{th} Annual Conference : Highlights

The 80^{th} Annual Conference of the Indian Mathematical Society was held at the Indian School of Mines (ISM), Dhanbad, Jharkhand during December 27-30, 2014 under the presidentship of Prof. S. G. Dani, IIT, Mumbai. The Conference was attended by more than 260 delegates. Two presidential addresses (General and Technical), one plenary lecture, by Prof. Gopakumar, HRI, Allahabad, four Memorial Award lectures and thirteen invited lectures were delivered. Also, four symposia were organized during the conference and twenty one invited speakers gave talks in the symposia. Moreover, in all 71 research papers were accepted for presentation at the Conference including 16 research papers for the paper presentation competition for various prizes.

The Conference was inaugurated by Shri. R. S. Singh, Director, Steel Plant Project, Electrosteel Castings Ltd., Bokaro. Prof. R. Balasubramanian, Chairman, NBHM was the Chief Guest for the inaugural function. The function was presided over by Prof. S. G. Dani. Prof. G. S. Seth, Head of the Mathematics Department, ISM, offered a warm welcome to the delegates. Prof. D. C. Panigrahi, Director, Indian School of Mines also addressed the gathering. The General Secretary of IMS, Prof. N. K. Thakare spoke about the Indian Mathematical Society and on behalf of the Society expressed his sincere and profuse thanks to the host for organizing the Conference. Prof. N. K. Thakare reported about the academic programmes of the Conference.

Prof. S. G. Dani delivered his Presidential address (General) on "Prizes, Recognitions and Promotion of Mathematics". The function ended with a vote of thanks by the Local Organizing Secretary, Dr. S. P. Tiwari.

Prof. S. G. Dani delivered his Presidential address (Technical) on "Dynamics of

Numbers which was presided over by Prof. N. K. Thakare, General Secretary of IMS.

- **Plenary Lecture**

Prof. Gopakumar, HRI, Allahabad delivered a Plenary Lecture on "The Remarriage of Mathematics and Physics".

- **Memorial Award Lectures**

1. The 28^{th} P. L. Bhatnagar Memorial Award Lecture was delivered by Prof. S. K. Tomar, Punjab University, Chandigarh on Wave propagation in local and nonlocal micro stretch elastic media.

2. The 25^{th} V. Ramaswami Aiyar Memorial Award Lecture was delivered by Prof. Sudhir Ghorpade, IIT, Mumbai on Number of solutions of systems of polynomial equations over finite fields.

3. The 25^{th} Srinivasa Ramanujan Memorial Award Lecture was delivered by Prof. B. V. Rajarama Bhat, ISI, Bangalore on Positivity in C* - Algebras and Hilbert C*- Modules.

4. The 25^{th} Hansraj Gupta Memorial Award Lecture was delivered by Prof. Ritabrata Munshi, TIFR, Mumbai on Rational points and L-functions via the circle method.

- **Various prizes awarded by the Society**

1. **A. Narasinga Rao Memorial Prize**

   This prize was awarded to Dr. Sanjay Kumar, Deenbandhu Chhotu Ram University of Sci. & Tech., Sonepat for the best paper published in the `Journal of the Indian Mathematical Society` and `The Mathematics Student` in the year 2012.

2. **P. L. Bhatnagar Memorial Prize**

   The prize for 2014 has been awarded to Mr. Sangik Saha (Kolkata West Bengal) for being the top scorer for the Indian Team at the 55^{th} International Mathematics Olympiad (IMO) held during July 3-13, 2014 at Cape Town, South Africa.

3. **Various prizes for the Paper Presentation Competition**

   A total of 16 papers were received for Paper Presentation Competition for Six IMS Prizes, AMU Prize and VMS Prize.

   There were 13 entries for six IMS prizes, no entry for the AMU prize and 3 entries for the VMS prize.

   Prof. Satya Deo (Chairperson), Prof. J. R. Patadia, Prof. S. K. Tomar and Prof. R. K. Upadhyay were the judges.

   Following is the result for the award of various prizes.

   IMS Prize - Group-1: There were 3 presentations and the Prize is awarded to Avinash Patil, Pune.

   IMS Prize - Group-2: There were 2 presentations and the Prize is awarded to Deepmala, Kolkata.

   IMS Prize - Group-3: No presentation.

   IMS Prize - Group-4: There were 2 presentations and the Prize is awarded to Ram Kishor, Ajmer (Rajasthan)

IMS Prize - Group-5: There were 4 presentations and the Prize is awarded to Santan Kumar, Dhanbad.

IMS Prize - Group-6: There were 2 presentations and the Prize is awarded to Anuj Kumar, Patna.

AMU Prize: No presentation.

V M Shah Prize: There were 3 presentations and the Prize is awarded to Garima Manocha, New Delhi.

- **Invited Talks**

(i) Probal Chaudhari, ISI, Kolkata : Deep inside data and distribution in dimensions

(ii) A. P. Singh, Central University, Rajasthan : Introduction to escaping sets of entire functions

(iii) M. A. Sofi, Kashmir University, Srinagar : Factoring Dvoretzky-Rogers Property

(iv) Bankteshwar Tiwari, BHU, Varanasi : Some aspects of Global Riemann-Finsler Geometry

(v) V. S. Kharat, S.P. Pune University, Pune : Air quality classification technique based on fuzzy logic

(vi) Ashis Upadhyay, IIT, Patna : Semi-equivelar maps on surfaces

(vii) Sanjib Kumar Datta, University of Kalyani, Kalyani : Effect of Relative Order and Relative Type on the Comparative Growth Analysis of Entire Functions

(viii) V. V. Joshi, S.P. Pune University, Pune : Becks Conjecture on zero divisor graphs and related aspects

(ix) Sanjay Kumar, Murthal (Sonepat) : Recent trends in fixed point theory

(x) A. K. Agarwal, Punjab University, Chandigarh : Basic series, lattice paths and modified lattice paths

(xi) P. Sundaram, NGM College, Tamilnadu : Digital Topology

(xii) J. N. Chaudhari, M. J. College, Jalgaon : On n-absorbing ideals in semirings

(xiii) M.P.Wasadikar, BAMU, Aurangabad : Modularity in multiplicative lattices and posets.

- **Symposia**

(i) Ergodic Theory and Dynamical Systems
Convener: Riddhi Shah, JNU, Delhi
Speakers : S. G. Dani (IIT, Mumbai), M. G. Nadkarni (Uni. of Mumbai), Srihari Sridharan (CMI, Chennai)

(ii) Nonlinear Analysis
Convener: Q. H. Ansari, AMU, Aligarh
Speakers: Joydeep Dutta (IIT, Kanpur), S. K. Mishra (BHU), D. R. Sahu, (BHU).

(iii) Number Theory
Convener : S. A. Katre, S.P. Pune University, Pune
Speakers : R. Thangadurai (HRI, Allahabad), Anirban Mukhopadhyay, K. C. Prasad (Central Univ., Ranchi), Susil Kumar Jena (Bhubaneswar), Ravi Kulkarni (Pune)

(iv) Chaos and Complexity in Nonlinear Phenomena Convener : R. K. Upadhyay, ISM, Dhanbad Speakers: R. Ramaswamy (Uni. of Hyderabad), M. Lakshmanan (Bharathidasan Uni., Tiruchirappalli), S. K. Dana (IICB, Kolkata), Vikas Rai (J. Nehru Uni., New Delhi) Snehashish Chakraverty (NIT, Rourkela), P.K. Roy, (NBRC, Delhi)

General Body Meeting

The General Body Meeting was held at 12.15 p.m. on December 30, 2014 in Golden Jubilee Auditorium of the Indian School of Mines, Dhanbad, Jharkhand.

The General Body Meeting was followed by the Valedictory Function. Various Prizes were awarded to the winners of Paper Presentation Competition during the Valedictory Function.

Prof. A. K. Agarwal (Past President of IMS), Punjab University, Chandigarh donated Rs. 1,20,000/- (Rupees One Lakh Twenty Thousand) as corpus fund to the IMS for instituting A. K. Agarwal Prize to be given every year for best publication in the year from all over the world in the areas of Number Theory, Combinatorics, Discrete Mathematics, Analysis and Algebra for which the winner will be given a cash prize of Rs. 10,000/- and a citation.

Profuse thanks and gratefulness were expressed to the host by the Office bearers and delegates for organizing a successful Conference.

Memorial Award Lectures

During every Annual Conference of the Society, the following Memorial Award Lectures are arranged as a part of the Academic Programme (each award lecture is of one hour duration with no other parallel session) :

1. P. L. Bhatnagar Memorial Award Lecture (Instituted in 1987).
2. Srinivasa Ramanujan Memorial Award Lecture (Instituted in 1990).
3. V. Ramaswami Aiyar Memorial Award Lecture (Instituted in 1990).
4. Hansaraj Gupta Memorial Award Lecture (Instituted in 1990).
5. Ganesh Prasad Memorial Award Lecture (Instituted in 1993 ; and delivered every alternate year).

Each of these lectures carry a token honorarium of Rs. 2500/- along with a citation.

- **Members of the Society are requested to suggest the names of the prospective speakers, along with their brief write-up, for these awards. The suggestions may be sent to Professor N. K. Thakare, the General Secretary of the Indian Mathematical Society up to June 30, 2015. His E-mail address is nkthakare@gmail.com**

IMS Sponsored Lectures

To popularize mathematics and to create awareness regarding the Society and its activities in the Country, the Society has a Scheme of **Sponsored Lectures**. It

provides a token support of Rs. 1000/- to a number of Departments / Institutions for organizing popular and semi technical lectures.

Prof. Ravi Kulkarni has also donated Rs. 1,25,000/- to organize **Meenakshisundaram Patodi lectures**.

Members arranging such lectures are required to send the report of the arranged lectures to The Treasurer, IMS, with a copy to The Editor, `The Mathematics Student`.

Society intends to enhance this activity of organizing such lectures at more and more centers. Members desirous to organize such lectures at their centers may write to the General Secretary Prof. N. K. Thakare through their respective heads.

Periodicals published by the Society

The Society publishes two periodicals: `The Journal of the Indian Mathematical Society` (JIMS; the Journal ; ISSN 0019-5839) and `The Mathematics Student` (Math Student; the Mathematics Student; ISSN 0025-5742), both of which are quarterly. The details can be found on the website: www.indianmathsociety.org.in/.

Subscriptions

♦ Annual subscription for the Journal / `The Mathematics Student` :
For each periodical

- Rs. 1500/- for Libraries of Educational Institutions in India - provided the subscription is direct or through an agent who gives complete name and address of the subscriber. The supply will be made directly to the subscribing library. If an agent subscribes for an educational Institution in India, the subscription is Rs. 1800/-.
- Rs. 6000/- for others for personal use or to the agents who do not supply the name and address of the end user.

- $150/- for personal use or for Libraries outside India.

The agents are entitled to 15 % discount on their orders.

From the 2012 issue of `The Mathematics Student` onwards, the life Members are given online access to `The Mathematics Student` / are sent the soft copy of `The Mathematics Student`, instead of supplying the hard copy, for their personal use (not for circulation) at their E-mail address registered with the Society.

Those Members who have not registered their E-mail address are requested to register it online on msgoesgreen@gmail.com .

It may please be noted that the contents of `The Mathematics Student` will continue to be available on the Societys website www.indianmathsociety.org and a physical copy of `The Mathematics Student` will continue to be available at the IMS Library (Ramanujan Institute of Advanced Study in Mathematics, Madras University, Chennai) as well as at the Registered Office of the Society (Department of Mathematics, S.P. Pune University, Pune 411 007) for reference during office hours.

Membership of the Society

Life Membership Fees:
Rs. 2000/- (US $1000/- for those residing outside India - referred to as *International Life Members*).

The Life Members of the Indian Mathematical Society who have registered their E-mail with the Society are entitled to a **FREE online access to** `The Mathematics Student` for their personal use (not for circulation). They can subscribe the Journal

at Rs. 1500/- (US $ 35/-) for their personal use (not for sale/resale).

Ordinary Annual Membership Fees:

Rs. 250/- (US $100/- for those residing outside India).

Sessional Membership Fees:

Rs. 250/- (US $100/- for those residing outside India). Sessional Members are those who join the Society only for a particular Session. They may contribute papers for presentation and / or participate in any of the academic programmes held during the Session.

- *Membership form is available on the IMS website.*

Business Correspondence and Payments:

All business correspondence be addressed to Prof. S. K. Nimbhorkar, Treasurer, IMS; Department of Mathematics, Dr. B. A. M. University, Aurangabad 431 004 (Maharashtra), India. All payments should be sent to Prof. S. K. Nimbhorkar, Treasurer, IMS by DD drawn in favour of **"The Indian Mathematical Society** payable at **Aurangabad** (Maharashtra), India at the address mentioned above.

Members in good standing:

A member is considered to be of good standing in a particular year if he/she has paid his/her Membership dues by **July 31**st of that year.

IMS Library:

The information pertaining to IMS library is available on the website (www.indianmathsociety.org.in/) of the society.

Guidelines for acceptance of Donations to the Society

1. There will not be any further institution of Memorial Award Lectures. (This point was discussed in the earlier meetings of the Council and such was the consensus).

2. The donation amount will not be less than Rupees Five Lacs. (There could be an upward revision of this amount from time to time).

3. The donor may be an individual or a trust or a group of individuals.

4. The Indian Mathematical Society will solely and independently own the amount donated to it.

5. A prospective donor should approach the General Secretary of the Indian Mathematical Society with a Offer. Keeping with the spirit of this Policy Guidelines and if so felt necessary, referring to the Council whether the proposal be negotiated or not, in his wisdom, the General Secretary will negotiate the terms and conditions for each donation proposal and will put it before the Council for its consideration and approval. The Council will deliberate on the proposal, and after modifications, if any, may accept the proposal through a special resolution with specific details mentioning the terms and conditions. This will be published in the IMS News Letter after the Donor agrees to the resolution of the Council.

6. Ordinarily during every Annual Conference of the Society there are several Invited Lectures and Symposia running in parallel sessions. One of these academic programmes may be permanently marked / identified as so and so sponsored programme in the (fond) memory of or so and so sponsored programme in the honour of as per the wish of each donor by the Council. This programme may be arranged in a parallel session during the Conference.

7. Each year, the Council through its Academic Planning Committee (APC) will be the final authority in this regard to finalize the name of a speaker of an invited talk or the names of the symposia speakers for this sponsored programme. The modus operandi for identifying the speaker(s) may be decided by the Council. The invited speaker(s) will be the guest of the host institution. In case of an honorarium, if any, to the invited speaker, the amount of the honorarium will not exceed the honorarium amount for the existing Memorial Award Lectures.

8. Ordinarily train travel to the extent of AC-2 Tier be reimbursed. However, in special cases the domestic air travel may be considered.

9. Not withstanding the above,

   (A). An offer of a donation with a stipulated purpose (not as part of the corpus), may be accepted by the Council on its merit.

   (B). An offer of a donation of any amount in general, without any stipulated conditions, may be accepted by the Council on its merit as a part of the General Purpose Corpus.

The Council reserves its right whether or not a particular donation be accepted.

Green initiative taken by the Society- A fervent appeal to all members of the Society

As a part of the "Green Initiative taken by the Society (for further details, refer Societys website www.indianmathsociety.org.in), the Council of the Society has decided to send online the soft copy of `The Mathematics Student` / give online access to `The Mathematics Student` to all the life members instead of supplying the hard copy. For

this purpose, all the members of the Society are requested to register their E-mail address online, along with Name and the **Unique Membership Number** therein, to J. R. Patadia on imsgoesgreen@gmail.com or jamanadaspat@gmail.com so that further necessary action can be taken.

- **Important Change**

This newsletter also includes as an Appendix the abstracts of accepted papers for presentation as well as abstracts of invited talks, etc. in the just ended annual conference. Since this issue of the newsletter this policy will be followed every year and such abstracts shall not be included in the issues of `The Mathematics Student`.

N. K. Thakare, General Secretary, IMS
c/o Center for advanced study in Mathematics,
Savitribai Phule Pune University,
Pune-411007 (M.S.)
March 25, 2015.

Appendix

Abstracts of the Plenary Talk and the IMS Memorial Award Lectures given at the 80^{th} Annual conference of IMS held at Dhanbad during December 27-30, 2014

Plenary Talk & IMS Memorial Award Lectures

The remarriage of mathematics and physics

Rajesh Gopakumar
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The histories of mathematics and physics have been inextricably entwined, with each enriching the other. However, in the middle of the twentieth century they had drifted apart with little communication between the areas. This has changed

in the last 20-30 years and one sees a renewed engagement between the disciplines. I will describe, from a theoretical physicist's perspective, some of the exciting ideas that have emerged from this cross-fertilisation. In particular, I will try to give a flavour of the so-called gauge-string duality which is creating new frontiers in the two subjects.

Positivity in C^*-algebras and Hilbert C^*-modules

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It is well-known that notions of positivity and positive functionals play an important role in the theory of C^*-algebras. In GNS theory we use them to recover underlying Hilbert spaces. Extending the concept of Hilbert spaces we have the notion of Hilbert C^* modules. These are spaces where there are inner products taking values in C^*-algebras and the positivity is the one mentioned above. In this talk, we briefly explain the basic concepts of the theory of Hilbert C^*-modules. On some aspects the theory is very much like that of Hilbert spaces, but there are surprises. Not all results of Hilbert space theory can be extended to this general theory as there are some intricacies.

Number of solutions of systems of polynomial equations over finite fields

Sudhir R. Ghorpade

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The number of roots of a nonzero polynomial in one variable (with coefficients in a field) is always bounded by its degree. On the other hand, a nonzero polynomial in several variables can have infinitely many roots. However, if the coefficients are in a finite field (such as, for example, the field of residue classes of integers modulo a prime number) and the roots are restricted to have coordinates in a finite field, then obviously there are finitely many solutions. Moreover, it is not difficult to find a nice bound depending on the degree of the polynomial and the size of the finite field. We can also consider the case of homogeneous polynomial in several variables with coefficients in a finite field and ask for the number of solutions, up to proportionality. In geometric terms, this corresponds to finding a bound on the number of points of a projective hypersurface over a finite field. Here the situation is a little more tricky and a plausible answer was conjectured by M. A. Tsfasman, which was later proved by J.-P. Serre (1991). Going further, one can consider a system of several multivariate homogeneous polynomials with coefficients in a finite field that are linearly independent and all of the same degree. We then ask for the maximum number of common zeros, up to proportionality. This question has been open for almost two decades and there are explicit conjectures due to Tsfasman and Boguslavasky. These questions are also intimately related to Coding Theory and the geometry of Veronese vari-

eties over finite fields. We will review these developments and report some recent progress.

Rational points and L-functions via the circle method

Ritabrata Munshi
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The circle method, in one form or the other, has always played an important role in analytic number theory. It was Ramanujan who first developed the method jointly with Hardy to understand the asymptotics of the partition function. After Ramanujan's death, Hardy and Littlewood applied this method in their study of rational points on varieties. In the last ninety years the circle method underwent major developments in the hands of several researchers. New ideas were incorporated, new variants were introduced and the method was applied to tackle new problems. Recently a"level lowering" technique was introduced in the circle method, which led to solutions of some important problems in the realm of automorphic L-functions and the study of the rational points on varieties. The talk will mainly focus on these breakthroughs.

Wave propagation in local and nonlocal microstretch elastic media

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Linear theory of local and non-local microstretch media were developed by Eringen under micro-continuum field theories. These theories are basically the generalizations of classical theory of elasticity. In micropolar theory of elasticity, during the deformation process, a typical particle of the medium can undergo rotation about its centre of mass, in addition to the displacement. In microstretch media, a particle can stretch (expansion or contraction), in addition to rotation and displacement during the deformation. Thus there are seven degrees of freedom in microstretch media (3 - translation, 3 - rotation, 1- stretch). The load across a surface element of microstretch media is given by force stress vector, couple stress vector and micro-stress vector. The possibility of propagation of plane waves through microstretch elastic media has been explored. Three types of microstretch elastic media have been considered for the study: (i) Local Microstretch elastic solid (ii) Local microstretch fluid and (iii) Non-local microstretch solid. Eringen's 3M-theories have been employed for mathematical treatment. Potential method has been used to decompose the displacement and micro-rotation vectors. It is found that five basic waves may travel through an infinite microstretch media of either solid or liquid. These waves are two sets of coupled longitudinal waves, two sets of coupled transverse waves and an uncoupled wave called longitudinal micro-rotational wave. The effect of non-locality of the microstretch solid has been seen on the speeds of all the waves by and large. These waves are found to be dispersive and attenuating in nature when propagating through microstretch fluid,

while they are dispersive but not attenuating in microstretch solid (local or non-local). The speed of propagation of these waves has been computed for a particular medium in order have a clear cut idea of their dispersion and attenuation characteristics. The phenomenon of reflection of a set of coupled longitudinal waves has been investigated in detail. The nature of dependence of various amplitude ratios have been depicted against the angle of incidence as well against the frequency of the incident wave.

Invited Talks

Introduction to escaping sets of entire functions

Anand P. Singh
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Let f be a transcendental entire function. For $n \in \mathbb{N}$, let f^n denote the n^{th} iterate of f. The set $F(f) = \{z \in \mathbb{C} | \{f^n\}_{n\in\mathbb{N}}$ forms a normal family$\}$ is called Fatou set and its complement is called Julia set. The set $I(f) = \{z \in \mathbb{C} | f^n(z) \to \infty$ as $n \to \infty\}$ is called escaping set of f. Eremenko proved an interesting fact that the boundary $\partial I(f) = J(f)$, linking

escaping set with Julia set, thus opening a new direction to the study dealing with Fatou set and Julia set. Here we give an introduction to this emerging theory on escaping sets and recent developments in this theory.

Deep inside data and distributions in dimensions one, two, three,. . . , infinity

Probal Chaudhuri
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A depth function is a statistical device for determining whether a point is close to the centre of a data cloud or a probability distribution, or whether it is away from the centre. The concept of depth function was originally developed for probability distributions and data in finite dimensional Euclidean spaces. With the recent advancement of scientific techniques and measurement devices, we often come across data that have dimensions much larger than the sample sizes. Such data cannot be handled using standard finite dimensional techniques. A common approach for handling such data is to embed them into suitable infinite dimensional spaces and model them using probability distributions in infinite dimensional spaces. There have been some recent attempts to extend the concept of depth function for data and probability distributions in Hilbert and Banach spaces. It has been observed that depth functions behave very differently in finite and infinite dimensional. The centre of a probability distribution, which can be defined as the deepest point, also has interesting properties

in infinite dimensional spaces. There are important statistical consequences of such behavior of a depth function and the associated deepest point.

Measuring of non-compactness and applications

M. Mursaleen
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In this talk, we present some applications of measures of non-compactness to the theory of infinite system of differential equations in some sequence spaces. We also present some new results on applications to integral equations.

Basic series, lattice paths and modified lattice paths

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In the paper [A.K. Agarwal and D.M. Bressoud, Lattice paths and multiple basic hyper geometric series, Pacific J. Math. Sci 20 (1997), no.4, 759-768.], the weighted lattice paths were introduced and used to prove that the generalized basic series identity found in [A.K. Agarwal, G.E. Andrews and D.M. Bressoud, The Bailey lattice, J. Indian Math. Soc. (N.S.) 51(1987-88), 57-73] was indeed the analytical counterpart of

an (n+t)-colour partition identity of Agarwal and Andrews [A.K. Agarwal and G.E. Andrews, Rogers-Ramanujan identities for partitions with "N copies of N", J. Combin. Theory Ser. A 45 (1987), no.1, 40-49.]. Recently, Agarwal and Sood in the paper [A.K. Agarwal and G. Sood, Split $(n + t)$-colour partitions and Gordon-McIntosh eight order mock theta functions, Electron. J. Combin., Vol. 21, Issue 2(2014), Paper#P2.46] introduced split $(n+t)$-colour partitions. These new partitions generalize Agarwal-Andrews $(n+t)$- colour partitions. They used these partitions to provide combinatorial interpretations of two basic functions of Gordon-McIntosh. Very recently, Sachdeva and Agarwal defined modified lattice paths which generalize Agarwal-Bressoud weighted lattice paths. In this talk we shall illustrate the relationship of these new combinatorial objects, that is, split $(n + t)$-color partitions and modified lattice paths with basic series and show how they can be used to find new Rogers-Ramanujan type identities.

Factoring Dvoretzky-Rogers property

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The famous Dvoretzky-Rogers(DR) theorem asserts that in each infinite dimensional Banach space X, it is possible to locate unconditionally convergent series that are not absolutely convergent. In other words, the (DR)-property is a finite-

dimensional (FD)-property which, by definition, is a generic term used for those properties of a Banach space that hold good in each finite dimensional space but fail in each infinite-dimensional Banach space. It is remarkable that these (FD) - properties typically share three important aspects which manifest themselves in an effort to salvage this property in an infinite dimensional setting. In this talk, it is shown that all these three features are witnessed in the case of the (DR) - property which involve:
a. Frechet space analogue of (P).
b. Size of the set of objects failing (P) in an infinite dimensional Banach space.
c. Factorisation property of (P).
As is typical in such situations, it turns out that whereas (a) leads to nuclear spaces as the right framework in which (DR)-property holds, (b) measures the extent to which the (DR)-property fails in an infinite dimensional Banach space. Finally, the factorisation scheme as envisaged in (c) leads to certain well known classes of Banach spaces which include Hilbert spaces on the one hand and the so called Hilbert-Schmidt spaces on the other.

Some new directions in fuzzy topology

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The notion of fuzzy topology on a set, as introduced in 1968 by C. L. Chang (J. Math. Anal. Appl., vol. 24), has been generalized in several ways. Many of these are modelled, using category theoretic language. One very recent and significant such generalization in 2014 is due to M. Demirci (Fuzzy Sets and Systems, vol. 256), via the notion of a $\mathbf{C}$-$\mathcal{M}$-L-topology, defined below:

Definition. *Let* $\mathbf{C}$ *be a category with products and* L *be a fixed* $\mathbf{C}$*-object and let* $\mathcal{M}$ *be a class of* $\mathbf{C}$*-monomorphisms. For a set* X*, an* $\mathcal{M}$*-morphism* $\tau \xrightarrow{m} L^X$ *is called a* $\mathbf{C}$-$\mathcal{M}$-L-**topology** *on* X *and the pair* $(X, \tau \xrightarrow{m} L^X)$ *is called a* $\mathbf{C}$-$\mathcal{M}$-L*-topological space.*
Given two $\mathbf{C}$-$\mathcal{M}$-L*-spaces* $(X, \tau \xrightarrow{m_1} L^X)$ *and* $(Y, \delta \xrightarrow{m_2} L^Y)$*, a function* $f : X \to Y$ *is called* $\mathbf{C}$-$\mathcal{M}$-L-**continuous** *provided that there is a (unique)* $\mathbf{C}$*-morphism* $r_f : \delta \to \tau$ *such that* $f_L^{\leftarrow} \circ m_2 = m_1 \circ r_f$*.*

The above notion generalizes a host of earlier generalizations and modifications of the notion of fuzzy topology. We give a general account of this generalization and concentrate thereafter on a particular case of it, which is the notion of a Q-topological space, introduced in 2008 by S.A. Solovyov (Fuzzy Sets and Systems, vol. 159) and defined as follows:
Let Q be any fixed member of any fixed variety of Ω-algebras in the sense of, e.g., G. Grätzer (*Universal Algebra, 2nd ed.*, Springer, 2008).

Definition. *Given a set X, a subalgebra τ of the Ω-algebra Q^X is called a Q-***topology** *on X and the pair (X, τ) is called a Q-***topological space**. *Given two Q-topological spaces (X, τ) and (Y, δ), a function $f : X \to Y$ is called Q-***continuous** *provided that $f_Q^{\leftarrow}(\nu) \in \tau$, for every $\nu \in \delta$.*

Q-topological spaces have been studied rather extensively by Solovyov. We also give here an account of some of its categorical aspects, as studied by us. In particular, we

- obtain an interesting injective cogenerator Q_S in the category Q-**TOP** of Q-topological spaces,
- characterize the category Q-**TOP**,
- obtain two intereseting epireflective hulls of Q_S, which respectively turn out to be the categories of T_0-Q-topological spaces and sober Q-topological spaces.

Some aspects of global Riemann-Finsler geometry

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In the present talk a brief review of Finsler geometry will be discussed especially comparative study of Riemannian and Finsler geometry. Riemannian geometry in the large has been discussed by many people since the beginning of the last century. In particular, curvature and topology of complete Riemannian manifolds is one of the main streams of differential

geometry. The key point for the development of Finsler geometry is the anti symmetric property of distance function on a Finsler manifold. Besides some modern development of the subject some properties of a complete Finsler manifold under existence of a strictly convex function will be discussed.

Air quality classification technique based on fuzzy logic

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The importance of study of air pollution with respect to various aspects is being analyzed by Pope et al. (2002), Dockery et al. (1993), Hastie et al. (1990), Cohen et al. (2004), Brauer et al. (2003), Salvi (2009), Elshout et al. (2008), Shiva Nagendra et al. (2007) and Mohammad Hossien et al. (2011).

The role of various techniques and models using mathematical tools along with computational perceptions is tackled and studied. In fact, fuzzy logic is found to be one of the effective methodologies to describe air quality straightway in linguistic terms with linguistic degree of certainty attached to each description. Also, an important aspect of establishing association between inhaling toxic air pollutants and incidence of respiratory diseases can be modelled with the help of knowledgebase of experienced pulmonologists using evidence theory and fuzzy relational calculus.

Also, some other aspects are studied and have an impact on some related areas of research.

Semi-equivelar maps on surfaces

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Semi-Equivelar maps are generalizations of maps on the surfaces of Archimedean solids to surfaces other than the 2-sphere. The well-known 11 types of normal tilings of the plane suggest the possible types of semi-equivelar maps on the torus and the Klein bottle. The surface of Euler characteristics-1 does not admit an equivelar triangulation, i.e. a triangulation in which degree of each vertex is same. However it admits semi-equivelar maps. We have been able to classify semi-equivelar on this surface with few vertices. Lifts of these maps and handle additions to these maps has resulted in proving existence of semi equivelar maps on other surfaces. This is an ongoing work and in this talk we present the results obtained so far.

Effect of relative order and relative type on the comparative growth analysis of entire functions

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In this talk some newly developed results related to the growth rates of composite entire functions on the basis of their gen-

eralized relative orders and generalized relative lower orders are discussed.

Free probability in high dimensional time series models

Arup Bose
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After a quick introduction to "free independence" we will show how ideas and results in free probability can be profitably used to study the limit spectral distribution of suitable polynomials of high dimensional sample autocovariance matrices for Infinite Dimensional Vector Linear Processes. We provide moment formulae of these limits in terms of moments of some freely independent variables. Explicit description of the limit is given in some special cases.

Beck's conjecture for zero divisor graphs of posets and related aspects

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This talk provides a background and discuss key issues of the theory of zero divisor graphs of posets. Mainly, we will be interested in the realization of zero divisor graphs of a

general poset and in particular, a Boolean poset. Further, we solve the isomorphism problem for the class of Boolean posets, SSC posets and lower dismentlable posets. Lastly, we discuss perfect zero divisor graphs of posets.

Digital topology

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Digital topology is the topology on the set Z of all integers having $\{\{2n-1, 2n, 2n+1\} : \text{n is an integer}\}$ as a subbasis. Some interesting properties are investigated.

On n-absorbing ideals in semirings

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Let R be a commutative semiring with identity element $1 \neq 0$. In this presentation, we describe n-absorbing ideals in R, which is a generalisation of prime ideals in R. Indeed we obtain n-absorbing ideals in the semiring of non-negative integers with respect to different binary operations. Also, we prove that if I is a Q-ideal in R and A is an ideal of R such that $I \subseteq A$, then A is a subtractive n-absorbing ideal if and only if $A/I_{Q\cap A}$ is a subtractive n-absorbing ideal in the quotient semiring $R/I_{(Q)}$.

Recent trends in fixed point theory

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In this talk basically we discuss development of metric fixed point theory from evolution of Banach fixed point theorem to recent development in metric fixed theory.

Symposium

Symposium on Ergodic Theory

Convenor: Riddhi Shah, JNU, New Delhi

Correspondence principles

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In the study of dynamical systems, correspondence principles are used to derive quantitative results about finite systems from qualitative results about continuous systems. In this talk we will discuss a few examples related to additive number theory and graph theory.

Dynamics of distal actions on locally compact groups

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We define distal actions on compact spaces and locally compact groups and we study the properties of distal maps and relate distality to some properties of the structure of the group, like unimodularity, polynomial growth.

Primitive solutions for Khintchine - Groshev type metric Diophantine problems

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We consider diophantine inequalities of the form

$$|\Theta\mathbf{q} + \mathbf{p} - \mathbf{y}| \leq \psi(|\mathbf{q}|);$$

where Θ is a $n \times m$ matrix, $\mathbf{y} \in \mathbb{R}^{\mathbf{n}}$, and ψ is a function of natural numbers with positive real values, and seek infinitely many integral solutions $\mathbf{v} = (\mathbf{q}, \mathbf{p})^t = (v_1, ..., v_{m+n})^t$ with the additional requirement that for any component $\{i_1, ..., i_l\}$ of

a given partition π of $\{1, 2, ..., m+n\}$, the vector $(v_{i_1}, ..., v_{i_l})^t$ is primitive, viz. $gcd(v_{i_1}, ..., v_{i_l}) = 1$. Some metrical results in the style of the classical Khintchine-Groshev Theorem will be discussed in this setting, for partitions π in which each component has at least $n+1$ elements.

Flat polynomials

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A sequence of trigonometric polynomials is said to be ultraflat if the sequence of their absolute squares converge uniformly to the constant function 1. It is said to flat if the absolute squares converges to 1 almost everywhere with respect to the Lebesgue measure. We will discuss flat and ultra flat sequence of polynomials and the connection of such polynomials with spectral questions in ergodic theory. Littlewood conjecture and Kahane's solution will be mentioned.

Symposium on Number Theory

Convenor: S A Katre, S.P.Pune University, Pune-411007

Liouville numbers and Schanuel's conjecture

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Schanuel Conjectured the following.

"Let $n \geq 1$ be an integer. Let $x_1, x_2, ..., x_n$ be any complex numbers which are linearly independent over $\mathbb{Q}$. Then among the following $2n$ numbers,

$$x_1, x_2, ..., x_n, e^{x_1}, e^{x_2}, ..., e^{x_n}$$

there are at least n numbers which are algebraically independent over $\mathbb{Q}$." We prove this conjecture for uncountably many Liouville numbers. This is a joint work with K. Senthil Kumar and M. Waldschmidt.

Finding smooth numbers

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For a $y \geq 2$, a positive integer n is called y-smooth if all prime factors of n are less than or equal to y. Let $\psi(x, y)$ be the number of y- smooth numbers $\leq x$. This quantity has been extensively studied and there are very good asymptotic formula available. One important method in this study is Buchstab's equlity

$$\psi(x, y) = \psi(x, z) - \sum_{y<p\leq z} \psi\left(\frac{x}{p}, p\right)$$

for $2 \leq y \leq z \leq x$. Our idea here is to use the Buchstab's identity to a general sequence $(a(n))_n$ of positive real numbers satisfying some standard conditions as in Sieve theory. We apply this to study smooth numbers in various arithmetic

sequences like values of polynomials with integral coefficients. This also applies to count the number of positive integers $n \leq x$ which is composed of primes between z and y for $z \leq y \leq x$. This is a joint work in progress with Kamalakshya Mahatab.

Some issues in Diophantine approximation of irrational numbers related with our works

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The talk aims at pinpointing some problems which have cropped up in our work on 'chain of theorems of Markoff and related Lagrange Spectrum'. These topics are central to the theory of 'Diophantine Approximation of irrational numbers'. Issues under discussion are:

• Relation between infinite approximation constant and at least one approximation constant of Markoff theorems.

• Question of location of approximations in Markoff theorems.

• Unification of first three theorems of Markoff and extension of Tong's Lemma.

• Nature of $\mathcal{L} \cap (\lambda - \epsilon, \lambda], \epsilon > 0$, where λ is the smallest cluster point of the set $\{\limsup M_n(\theta) | \theta \in I_4\}$, I_4 being the set of all irrational numbers having infinitely many partial quotients ≥ 4.

On some Diophantine equations

Susil Kumar Jena

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In this talk, we mainly give an overview of our work on some Diophantine equations of the form $mA^p + nB^q = kC^r$ where m, n, k, p, q, r are positive integers and $1/p + 1/q + 1/r \leq 7/6$. We generalise some of our published theorems relating to these equations; and present some new results.

Matrices over noncommutative rings as sums of cubes

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L. N. Vaserstein has shown that if R is a ring, not necessarily commutative, then for $n > 1$, an $n \times n$ matrix A over R is a sum of squares if and only if its trace is a sum of squares mod 2. In this talk we show that A is a sum of cubes if and only if trace of A is a sum of cubes and commutators in R. We give an example where a matrix is a sum of cubes but its trace is not a sum of cubes mod 3. This is a joint work with Kshipra Wadikar.

Idempotents in rational group algebras

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Let G be a finite group, F a field of characteristic 0, and $R := F[G]$, the corresponding group algebra. The "arithmetic" of F, reflects in the idempotents in R, and is closely related to the representations of G over F. We shall discuss our recent work with Soham Pradhan when G is a solvable group and $F = Q$, the field of rational numbers. In particular, when G is abelian, there are many pretty formulas involving exponential sums.

Symposium on Chaos and Complexity in Nonlinear Phenomena

Convenor: Ranjit Kumar Upadhyay, ISM, Dhanbad-826004

Chimera states in globally coupled nonlinear oscillators

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Identifying collective dynamical states in coupled nonlinear oscillators, which individually exhibit regular or chaotic motions, is a challenging problem of considerable physical and mathematical relevance. Considering globally coupled identical oscillators having intensity dependent interactions, we

identify besides synchronized and desynchronized states the so called chimera states (partially coherent and partially incoherent) of different types like amplitude chimeras, frequency chimeras, breathing chimeras, clusters, multichimeras, etc. We identify the reason behind the existence of these chimeras as due to the increase in the number of fixed points and multistable attractors. As typical examples, we will consider the nonlinear dynamics of coupled van der Pol and coupled Rössler oscillators with additional intensity dependent terms and also Stuart-Landau oscillators, all with global coupling.

Chimera states in a population of identical oscillators under planar cross-coupling

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In a chimera state, a large population of identical oscillators splits into two subpopulations where one population is coherent and the other remains in an incoherent state. This spontaneous breaking of symmetry in a network of non-locally coupled identical phase oscillators was first noticed about a decade ago. The chimera states were observed later in networks of many systems including chaotic system. Moreover, it had been evidenced in several experiments, chemical oscillators, optical system, electronic circuits and mechanical clock. However, the non-locality condition of the coupling configuration was found important for the phenomenon while it is also sensitive to initial conditions.

In contrast, the chimera states are reported very recently in a globally coupled network of identical oscillators where the stringent condition of non-locality in the coupling configuration is found redundant.

We supported this slackening of the condition of non-locality coupling by further revealing the existence of the chimera states in an assembly of identical nonlinear oscillators (limit cycle van der Pol system or chaotic Rössler oscillators) that are globally linked to each other in a simple planar cross-coupled form. This finding further simplifies the existence criterion for chimeras and thereby broadens the range of their applicability to real world situations.

Chimeras in coupled phase oscillator systems

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Collective phenomena in nonlocally coupled systems has attracted considerable attention due to the existence of interesting states such as the chimeras. Given the ubiquity of such states, one need to explore the relationship between the form of the nonlocal coupling and the nature of resulting chimera. We investigate the chimeras in a system of phase oscillators with piecewise linear nonlocal coupling. We show that it is possible to design chimera states with any desired number of coherent (or incoherent) regions by suitably constructing the coupling kernel. Chimeras with odd numbers of coherent re-

gions will have all clusters in-phase with one another, while chimeras with even numbers of clusters can have clusters that are out-of-phase with each other.

Uncertain data based system identification of structural systems by neural network modeling

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System identification methods of structural dynamics, in general solve inverse vibration problems to identify properties of a structure from measured data. The use of computers and efficient mathematical algorithms allow identification of the process dynamics by evaluating the input and output signals of the system. The result of such process identification is usually a mathematical model by which the dynamic behaviour can be estimated or predicted.

Models and parameters of practical application are usually established on the basis of plans, drawings, measurements, observations, experiences, expert knowledge, codes and standards and so on. In general, exact information and precise values of parameters do not exist. Various uncertainties may result from human mistakes, errors in the manufacture and construction and from the lack of information. In order to perform realistic science and engineering analysis and proper safety assessment, the uncertainty in both data and models must be appropriately taken into consideration. Basically

these uncertainties may be handled by probabilistic, fuzzy or interval analysis. In probabilistic approach, uncertain variables are considered as random variables with a joint probability density function. Unfortunately, probabilistic methods may not deliver reliable results at the required precision without sufficient data. As such fuzzy and interval theory are becoming powerful tools for many applications in the recent decades.

Accordingly, in this paper identification methodologies for structural systems has been proposed using the powerful technique of Artificial Neural Network (ANN) models which can handle uncertain data in term of interval/fuzzy. Identification with crisp data is known and also neural network method has already been used by various researchers for this case. Here, the input and output data may be in uncertain form. Uncertain data is assumed in term of interval/fuzzy and the corresponding problem of system identification through the solution of complex differential equations has been investigated.

Deciphering dynamics of recent epidemic spread and outbreak in West Africa: The case of Ebola virus

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Recently, the 2014 Ebola virus (EBOV) outbreak in West Africa is the largest outbreak to date. To better understand the spread of infection, an attempt has been made to un-

derstand the Ebola outbreak using epidemic modeling. This paper mainly deals with the spread of Ebola virus in West Africa in 2014 and its effect on the human population by qualitative and quantitative analysis using an SEIR (Susceptible-exposed-Infectious-recovered) model and fit the model to the most recent reported data of infected cases and deaths in Guinea, Liberia and Sierra Leone. The model exhibits two equibria, namely, the disease-free and unique endemic equilibria. The existence and local stability of the disease free and endemic equilibria are explored in terms of the basic reproduction number R_0. Using the results of Central manifold theory, it is established that as R0 passes through unity, transcritical bifurcation occurs in the model system and the unique endemic equilibrium is asymptotically stable. The constructed model provides an estimate to the potential number of future cases. The model indicates that the disease will decline after peaking if certain recovery rate is maintained. The model indicates that the effective reproduction number might have dropped to around unity. Possible implications of the results for disease eradication and its control are discussed which suggests that proper control strategies in West Africa is needed to stop the recent outbreak.

Simplicity and complexity in predator-prey-parasite system

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Parasites are recognized as one of the major players in the functioning of ecosystem and biodiversity. Predators, on the other hand, can dramatically shape community structure and ecosystem properties. It becomes particularly interesting in host-parasite systems because predation itself can strongly alter population dynamics of hosts and parasites. Coupled effects of parasites and predators are expected to be the key regulatory in the outcomes of most predator-prey-parasite (PPP) interactions and in the community structure. We demonstrate that a PPP model can exhibit very simple stable dynamics to very complicated chaotic dynamics under different biological assumptions.

Symposium on Nonlinear Analysis

Convenor: Qamrul Hasan Ansari, Aligarh Muslim University, Aligarh

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Exact regularization of monotone variational inequalities

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The notion of exact regularization in convex optimization has been an important issue in the recent past since it has many applications. The idea is to add a regularization term to the objective function and then solve a sequence of regularized

problem over the same feasible set by driving the regularization parameter to zero. Exact regularization tries to find under what conditions we can guarantee the existence of a regularization parameter such that the solution of that particular instance of the regularized problem is a solution of the original convex optimization problem. We now ask ourselves the question of what could be the meaning of exact regularization for monotone variational inequalities. We present in this talk the progress we have made in this direction by showing the fundamental role of the dual gap function associated with a monotone variational inequality.

Some results on approximation theory and invariant points

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G. Meinardus (1963) initiated the study on application of fixed point results in approximation theory in normed linear spaces. Approximation theory in general has varied applications in nonlinear analysis. In 1969 Brosowski generalized the result of Meinardus and gave the following result on invariant approximation using fixed point theory in the same space.

Theorem A Let T be a linear and nonexpansive operator on a normed linear space E. Let C be a T-invariant subset of E and x a T-invariant point. If the set $P_C(x)$ of best C-approximants to x is nonempty, compact and convex, then it

contains a T invariant point.

S P Singh (1979) observed that the linearity of the operator T and convexity of the set $P_C(x)$ in Theorem can be relaxed and proved the following result:

Theorem B Let $T : E \to E$ be a nonexpansive self mapping of a normed linear space E. Let C be a T- invariant subset of E and x a T-invariant point. If the set $P_C(x)$ is nonempty, compact and starshaped, then it contains a T-invariant point.

Further Singh (1979) showed that Theorem B remains valid if T is assumed to be nonexpansive only on $P_C(x) \cup \{x\}$. All these lead to a number of results in this direction by different researchers, which are noted in Rao and Mariadoss (1983), Mukherjee and Som (1985), Mukherjee and Verma (1985), Sahab and Khan (1987), Narang and Chandok (2009, 2010), Asnaashari (2012), Chandok and Narang (2012) etc which generalized the result of Brosowski.

In this talk we present some similar types of results on T-invariant points for the set of best simultaneous approximation to a pair of points x_1, x_2 in a metric space (X, d) from a set C, which is not necessarily starshaped but has a jointly continuous contractive family. Some results on T-invariant points for the set of best approximation are also obtained. The results deduced in this work generalize and extend some of the results of authors mentioned above and of many others in turn.

Ekeland's variational principle and its extensions with applications

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In this talk, we present several forms of Ekeland's variational principle, its equivalence with Takahashi's minimization theorem and some applications to fixed point theory and weak sharp minima. We discuss equilibrium problem which is a unified model of several problems, namely, minimization problem, saddle point problem, Nash equilibrium problem, fixed point problem, variational inequality problem, etc. We present equilibrium version of EVP and prove the equivalence with some other problems. We use such EVP to establish the existence of a solution of an equilibrium problem without convexity assumption on the underlying set.

On Minty variational principle for nonsmooth vector optimization problems with approximate convexity

S. K. Mishra
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We formulate approximate vector variational inequalities of Stampacchia and Minty type and apply these vector variational inequalities to characterize an approximate efficient

solution of a vector optimization problem involving locally Lipschitz approximately convex functions.

Perturbed iterative techniques with applications

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During the last two decades, different modifications of fixed point and proximal point iterative techniques were introduced for solving various nonlinear problems in Hilbert and Banach spaces. We combine these modifications to get some new perturbed iterative algorithms. These techniques are applied to solve fixed point problems and inclusion problems.

IMS Prizes

Group-1: Discrete Mathematics, Lattice Theory, Set Theory, Logic, Number Theory and related areas

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Zero-divisor graphs of dismantlabale lattices-II

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In this article, we study the zero-divisor graph of lower dismantlable lattices. We prove that a zero-divisor graph of a lower dismantlable lattice with $(0;1)$ as an adjunct pair is complete bipartite if and only if the lattice is 0-distributive. An isomorphism problem is completely settled for the zero-divisor graph of lower dismantlable lattices with 1 join-reducible.

A characterization of N-connected splitting matroids

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The splitting operation on an n-connected binary matroid may not yield an n-connected binary matroid. In this paper, we characterize n-connected binary matroids which yield n-connected binary matroids by the generalized splitting operation.

k-Partitions of hypercubes into regular connected subgraphs

Amol Sonawane

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In this paper, we consider the problem of partitioning the edge set of Q_n into spanning, regular and connected subgraphs. We prove that if $n = n_1 + n_2 + \cdots + n_k$ with $n_i \geq 2$ for $i = 1, 2, \ldots, k$; then the edge set of Q_n can be partitioned into k spanning subgraphs G_1, G_2, $\ldots, G_k$ such that G_i is n_i-regular and n_i-connected for $i = 1, 2, \ldots, k$.

Group-2: Algebraic Geometry, Geometry, Topology, Algebraic Topology and related areas

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On solvability of Functional equations arising in dynamic programming of multistage decision processes

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In mathematics and computer science, dynamic programming is a method for solving complex problems by breaking them down into simpler steps. Bellman functional equation, named after its discoverer, Richard Bellman, is a necessary condition for optimality associated with the dynamic programming (a mathematical optimization method) and describe the process of solving problems where one needs to find the best decisions

one after another. It breaks a dynamic optimization problem in to simpler sub problems and describes the relationship between these sub problems. In this paper, we use a fixed point theorem as a tool to show the existence and uniqueness of the solutions for a generalized functional equations arising in dynamic programming of multistage decision making processes in Banach spaces. Our main results extend, improve and generalize the results due to several authors. An example is provided for indicating the natural realizations of our result presented in the paper.

Group-3: Measure Theory, Probability Theory, Stochastic Processes,and related areas.

No abstract received

Group-4: Differential/Integral/Functional equations and inequalities, Special Functions, Numerical Analysis and related areas

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Boundedness of impulsive functional differential equations in which state variable relaxed to time delay

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In this paper boundedness of impulsive functional differential equations in which the state variable on the impulses are related to the time delay is considered. By using Lyapunov functions coupled with Razumikhin techniques, some criteria of uniformly boundedness of solution of impulsive functional differential equations are provided.

Group-5: Solid Mechanics, Fluid Mechanics, Electro-magnetic Theory, MagnetoHydrodynamics, Astronomy, Astrophysics, Relativity and related areas

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Edge waves in a homogeneous pre-stressed anisotropic plate

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This paper aims to study the edge wave propagation in a uniformly homogeneous pre-stressed anisotropic (viscoelastic)

plate. Frequency equation of edge wave has been established in closed form. It is observed that compressive initial stress, tensile initial stress and frequency parameters have their substantial effect on the phase velocity of edge wave.

Moon-perturbed energy surfaces and equilibrium points in the Sun-Earth system

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In this paper we determined the perturbation of the Moon moving around the Earth in the Sun-Earth restricted three body problem i.e., bi-circular model. The analysis is done using the theoretical tools for the determination of equilibrium points, zero velocity surfaces. In this analysis we find that there are significant perturbations in the Lagrangian points except L_3 point. According to this prevalence, the Sun-(Earth-Moon) model is used to design the trajectory and its transformation for spacecraft traveling under this assumption.

Linear stability in case of resonances in the photogravitational restricted three body problem with an oblate body

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We have considered the well-known restricted three body problem under the influence of perturbations in the form of radiation pressure and lack of sphericity of the primaries, respectively. In the present article, author is interested to analyzed linear stability in case of three main resonances and hence, effect of perturbations on the stability regions. In order to achieve the goal, first, we have determined triangular equilibrium point then examined its linear stability and found that points are stable for the mass ratio $0 < \bar{\mu_c} < 0.0396478$, in the presence of perturbations. Perturbed mass ratio for three main resonance cases is obtained and noticed that it is increasing function of radiation pressure but it decreases with respect to oblateness. It is also, observed that stability region expands with radiation pressure, in the presence and absence of oblateness but it contracts with oblateness. Again, effects of perturbations are analyzed and found that they affects the motion of restricted mass significantly, in space. Results are helpful to study more generalized problem in the presence of some other type of perturbations such as P-R drag and solar wind drag etc.

Propagation of Love-type wave in two distinct vertically heterogeneous layers overlying an initially stressed half-space

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The current study deals with the propagation of Love-type wave in a heterogeneous layer lying over another heterogeneous layer and an initially stressed isotropic half-space. The heterogeneity in the uppermost and intermediate layer is assumed to vary as quadratic and exponential functions, respectively, of space variable pointing positively downward. The dispersion equation has been obtained in closed form and reduced to classical Love wave equation as particular case of the problem. The effect of presence and absence of the different sort of heterogeneity in the layers and initial stress on the phase velocity has been depicted by means of graphs.

Shear wave propagation in a monoclinic crystalline medium influenced by smooth moving punch

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The present study analyzes the effect of semi-infinite smooth moving punch on the shear wave propagation in an initially stressed magnetoelastic monoclinic strip. The expression of dynamic stress concentration due to the punch for the force of a constant intensity has been obtained in closed form and some important observations have been made. The study reveals that speed of moving punch associated with shear wave speed in the medium, vertical compressive initial stress, vertical tensile initial stress and monoclinic magnetoelastic coupling parameter have significant effect on dynamic stress con-

centration due to semi-infinite smooth moving punch. These effects have been observed through graphical demonstration.

Group-6: Operations Research, Optimization, Computational Mathematics, Information Technology, Biomathematics, History of Mathematics and related areas

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Modeling the impact of Rabbit Hemorrhagic disease on the generalist predator: The case of red fox

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A qualitative analysis of an eco-epidemiological model with simple law of mass action and Hollingtype III functional response is carried out. This paper focuses on the spread of rabbit hemorrhagicdisease (RHD) in the European rabbit population and its effect on the red fox (Vulpesvulpes).Existence and uniqueness of solutions are established and shown to be uniformly bounded. Criteriafor diffusion-driven instability caused by local random movements of European rabbits and red fox are obtained. We found that diffusion coefficients and transmission rate have appreciable influence on spatial spread of epidemics. Possible implications of the result for disease eradication and its control which in turn may increase the population of rabbit are discussed.

AMU Prize: No abstract received

V M Shah Prize

A study of certain results on spectrum and summability for a class of entire Dirichlet series having complex frequencies

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Let F be a class of entire functions represented by Dirichlet series with complex frequencies for which $(e^{c_1 k}|\lambda^k|/|\beta_k|^{c_2})|a_k|$ is bounded. In the present paper certainresults based on spectrum of a set and a summable sequence are studied for the set F.

Some approximation results by a Kantorovich type q-Bernstein-Stancu operators

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In the present paper, a Kantorovich type generalization of q-Bernstein-Stancupolyno-mials has been introduced. Basic convergence results of the introduced operators and also the rateof convergence by these operators in terms of the modulus of continuity has been obtained. Further, local approximation property and Voronovskaja type theorem for the said operators has been studied. Comparisons and some illustrative graphics for the convergence of operators to a function is presented.

Papers

A: Combinatorics, Graph Theory and Discrete, Mathematics

Conditional coloring of middle graph of wheel graph

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For integers r and $k > 0$, (where $r \leq k$), a conditional (k, r)-coloring of a graph G is a proper k-coloring of the vertices of G such that every vertex v of degree $d(v)$ in G is adjacent to vertices with at least $min\{r, d(v)\}$ differently colored neighbors. The smallest integer k for which a graph G has a conditional (k, r)-coloring is called the r-th order conditional chromatic number, denoted by $\chi^r(G)$. In this paper, we obtain r-th order conditional chromatic number of middle graph of wheel graph $M(W_n)$ for different values of r.

k-Partitions of hypercubes into regular connected subgraphs

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In this paper, we consider the problem of partitioning the edge set of Q_n into spanning, regular and connected subgraphs. We prove that if $n = n_1+n_2+...+n_k$ with $n_i \geq 2$ for $i = 1, 2, \ldots, k$;

then the edge set of Q_n can be partitioned into k spanning subgraphs $G = G_1 + G_2 + + G_k$ such that G_i is n_i-regular and n_i-connected for $i = 1, 2, \ldots, k$.

Some aspects of unitary addition Cayley graph of Gaussian integer modulo n

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Let $Z_n[i]$ be the set of Gaussian integers modulo n. For any positive integer $n > 1$, the unitary addition Cayley graph of Gaussian integer modulo n is given by $G_n[i]$ with vertex set $Z_n[i]$ and edge set $U_n[i]$, where $U_n[i]$ is the set of all units in $Z_n[i]$. Any two vertices $a + i.b$ and $c + i.d$ will be adjacent in $G_n[i]$ if and only if gcd $(N((a + c) + i.(b + d)), n) = 1$, where $N((a + c) + i.(b + d)) = (a + c)^2 + (b + d)^2$. In this paper we obtain some results on the total number of elements and unit elements of the set $Z_n[i]$ for different forms of n. We investigate some graph theoretic properties such as vertex degree, number of edges, diameter and girth of the graph and also obtain condition for which the graph $G_n[i]$ is Eulerian and Hamiltonian.

B: Algebra, Number Theory and Lattice Theory

Some results on strongly regular near-rings

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In this paper we have generalized some results on strongly regular near-rings which are closely related with strongly reduced near-rings. A near-ring is said to be left regular if for each $a \in R$, there exists $x \in R$ such that $a = xa^2$ .A near-ring is called strongly left regular if R is left regular and regular, similarly we define right regular. A strongly left and strongly right regular near-ring is called strongly regular near-ring. Equivalently left and right regularity implies strong regularity. Also the concept of left, strongly left, strongly right and strong regularities are all equivalent. An idempotent element e in R is called left semi central if $ea = eae$ for $a \in R$. Similarly right semi centrality can be defined in a symmetric way. A near-ring in which every idempotent element is left semi central is called semi central. A near-ring R is reduced if R has no non-zero nilpotent elements. We see that a strongly regular near-ring is reduced and every strongly reduced near-ring is reduced.

Z_J-ideals in lattices

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In this paper, we defined Z-ideals, Z_j-ideals in bounded lattices and obtained some characterization.

Some remarks on fuzzy ideal

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Fuzzy set theory was first propounded by Zadeh in 1965. Subsequently, Rosenfeld did pioneering work by applying fuzzy sets to the realm of group theory and formulated the concept of a fuzzy subgroup of a group with respect to the t-norm Minimum. Since then, a host of mathematicians have been engrossed in extending the concepts and results of abstract algebra to the broader framework of the fuzzy setting.
So, motivated by the above, in this paper our aim is to study the property of fuzzy ideal. Fuzzy ideal of a group were studied by Rosenfeld (1971) and Liu (1982) introduced the notions of fuzzy ideals of a ring. Here, we have derived some results over it following the notion of Liu.

On 2-absorbing primary ideals of the semiring Z_0^+

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Let R be a commutative semiring with identity $1 \neq 0$.In this paper, we introduce the concept of 2-absorbing primary ideals in R, which is a generalization of primary ideals and obtain the characterizations of 2-absorbing primary ideals of the semirings $(Z_0^+;$ gcd; lcm) and $(Z_0^+; +; \cdot)$.

Skew cyclic codes over a finite non-chain ring

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Let $R = F_3 + vF_3 = \{0, 1, 2, v, 2v, v + 1, v + 2, 2v + 1, 2v + 2\}$ be a ring, where $v^2 = 1$. In this paper, we study skew cyclic codes over R and investigate the structural properties of skew polynomial ring $R[x, \theta]$and the set $R[x, \theta]/ < x^n - 1 >, \theta$ where is a non trivial automorphism of R. Further, we prove that skew cyclic codes over R are equivalent to either cyclic codes or quasi cyclic codes.

C: Real and Complex Analysis

Jain-Baskakov operators and its different generalization

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The aim of this work is to introduce new sequence of positive linear operators, which is integral version of Jain operators. We studied some direct results in ordinary approximation. Weighted approximation, rate of convergence and A-statistical convergence are investigated. Also, we discussed approximation properties of King-types and Stancu-types generalization of these new sequence of linear positive operators and investigated modification of Jain-Baskakov operators with parameter c. At the end, propose q-analogue of Jain operators based on q-integers.

(p, q)-th 0rder based growth analysis of composite entire functions

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In this paper we investigate some (p, q)-th order ((p, q)-th lower order) oriented growth properties of composite entire functions improving some existing results.

On relative order oriented results of entire functions of two complex variables

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In this paper we intend to find out relative order (relative lower order) of an entire function of two complex variables f with respect to another entire function of two complex variables g when relative order (relative lower order) of f and relative order (relative lower order) of g with respect to another entire function h of two complex variables are given.

Weighted sharing and uniqueness of meromorphic functions

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In this paper, we study with a weighted sharing method the uniqueness problem of $[f^nP(f)]^{(k)}$ and $[g^nP(g)]^{(k)}$ sharing one value and obtain some results which extend and improve the results due to Hong-Yan Xu and Ting-Bin Cao.

Uniqueness of difference polynomials of meromorphic functions

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In this paper, we consider the zero distributions on the derivatives of q-shift difference polynomials of meromorphic functions with zero order, and obtain two theorems that extend results of Kai Liu, Xiu-Ling Liu and Ting-Bin Cao [45].

Fourier transform and its inverse for functions of bicomplex variables

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In this paper we examine the existence and region of convergence of Fourier transform and inverse Fourier transform for functions of bicomplex variables with the help of projection on its idempotent components as auxiliary complex planes. Also we are promoting some useful properties of Fourier transform in bicomplex variables

D: Functional Analysis

Fixed point theorem for Mizoguchi-Takahashi contraction on a metric space endowed with a graph and applications

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In this article we generalize Mizoguchi-Takahashi's fixed point theorem for mappings on a metric space endowed with a graph. As an application of this result, we present a fixed point result for mappings satisfying Mizoguchi-Takahashi contractive condition uniformly locally. Finally, we obtain a theorem on the convergence of successive approximations for some nonlinear operators on a Banach space as another application. As consequences of the last result, we get the famous Kelisky-Rivlin theorem on iterates of the Bernstein operators on $C[0,1]$ and establish the convergence of iterates of certain nonlinear Bernstein type operators on $C[0,1]$.

The finite fractional Hankel transformation

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In this paper the finite fractional Hankel transformation has been defined depending on three real parameters. For this purpose, two differential operators having the same positive eigenvalues and respective system of eigenfunctions verify the same orthogonality condition, are considered. Operational calculus properties are shown in an application problem at the end of the paper. The classical concept on a more generalized version of Finite fractional Hankel Transforms is studied. Then the testing function spaces and their duals are constructed such that certain Fourier-Bessel series converge.

Hankel-Clifford integral transformation of arbitrary order

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In this paper Hankel-Clifford integral transformation h_ν is defined where inverse formula coincides with itself. We extend the Hankel-Clifford integral transformation to arbitrary values of as $h_{\nu,q}$ Moreover, we obtain some results for this extension. This transformation is used to solve a differential equation involving the Bessel operator.

Generalized implicit vector equilibrium problem with vector relaxed monotonicity

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In this paper, we introduce a new concept of vector relaxed $\alpha-C$-monotonicity for bi-mappings. Using the KKM technique, we establish existence result of generalized implicit vector equilibrium problem with vector relaxed $\alpha - C$-monotonicity in topological vector spaces. One example is also given.

Convergence of SP-iteration for generalized nonexpansive mapping in Banach spaces

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In this paper, we study the convergence behaviour of SP-iteration scheme with respect to class of mappings which employed the condition (C). One weak convergence theorem and two strong convergence theorems in uniformly convex Banach spaces are obtained. Thus, our results generalized and improved many existing results in the literature.

E: Differential Equations, Integral Equations and Functional Equations

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Proof of Khabibullin's conjecture on integral inequality in terms of increasing function

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Khabibullin's conjecture on integral inequality in terms of increasing function is still an unsolved question. In this paper, a possible proof of this conjecture has been shown with proper analysis and on the basis of the analysis, a modified statement of the conjecture has also been proposed. In order to prove the main conjecture , some new results have been introduced which have been stated as Lemma 1 and Lemma 2 and finally, the modified statement of this conjecture has been stated as Theorem 3 followed by the proof. This paper also consists of an example and a condition imposed on a function to satisfy the conjecture.

Existence and locally attractivity results for fractional functional order random integral equation

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In this paper, the existence and locally attracitvity results are proved for nonlinear random integral equation of fractional order in Banach space under lipschitz and Caratheodory conditions. The topological random fixed point theorem is the main tool in carrying out our proof.

Approximate solution of variable order differential equation using homotopy analysis method

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In the present manuscript the Homotopy analysis method is applied to solve the variable order fractional diffusion equation with source term. Though the equation are already been solved using numerical methods, but, it is first of its kind to find the solutions of these types of equations using the efficient and reliable semi analytical method known as Homotopy analysis method.

F: Geometry

Symmetries of type N pure radiation fields along the Ricci solution in Einstein manifolds

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The present paper puts an emphasis on the description of Ricci solitons with a physical interpretation of the notion of the vector field occurring in the definition. We investigate the geometrical symmetries of Petrov type N pure radiation fields along the vector field associated to Ricci solitons.

Some problems in an almost product and almost decomposable spaces

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Sinha (1971) has studied H-projective curvature tensor in an almost decomposable manifold. Sinha (1973) has studied H-curvature tensor in Kaehler manifold. Further, Negi (2008) has studied some investigations in Kaehlerian spaces with recurrent H-curvature tensors. In the present paper, I have

defined and studied almost product and almost decomposable spaces and several theorems have been derived. Every recurrent space is H-projective recurrent space, Weyl recurrent space, conformal recurrent space, conharmonic recurrent space, concircular recurrent space.

G: Topology

On topological charaterizations of generalized rough multisets

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The purpose of this paper is to investigate the relationship between multiset topology (M-topology) and generalized rough multiset induced by mutiset (mset) relation on the universe which is not restricted to be finite. The notion of transitive closure and equivalence closure of a relation in multiset context are proposed. Specifically, we show that (i) any serial mset relation induce an M-topology (ii) any reflexive mset relation R and its transitive closure $\tau(R)$induce the same M-topology, i.e., $\tau(R) = \tau(t(R))$, and (iii) any tolerance mset relation R and its equivalence closure $e(R)$ induce the same M-topology, i.e., $\tau(R) = \tau(e(R))$.

Local function in generalized ideal topological spaces

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In this paper, we have observed significant properties of local function of set in the generalized ideal topological space. Further we have constructed some examples of local function in generalized ideal topological spaces.

H: Measure Theory, Probability Theory and Stochastic Processes, and Information Theory

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Optimization of a multi item inventory model using triangular intuitionistic fuzzy number

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Inventory represents a substantial investment capital for many firms. The multi item inventory models varies from the single item in the sense that the models developed for the later are independent of all items being carried in the inventory. The control of multi item inventory is crucial as they work under a number of constraints. The present paper deals with a multi item inventory model under budget and storage space capacity constraints. .The objective is to minimize the total inventory cost under the given constraints. The demand in the model is considered a triangular intuitionistic fuzzy number. Then

by Karush Kuhn Tucker condition the problem is solved. The model is illustrated through a numerical example.

Formulation of fuzzy variable based non-linear programming techniques for reliability assessment of complex system

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Non-linear programming problem is originally developed for static data. Recently, researchers have proposed variants of non-linear programming for optimization in uncertain situations. In this paper, we have presented fuzzy non-linear programming with fuzzy variable to compute the reliability of a complex system. We have considered the component's reliability of the system as fuzzy variable, represented by triangular fuzzy numbers. Then the problem is reduced to crisp multi-objective non-linear programming problem and solved by max-min operator. The proposed procedure is applied on two stage complex system reliability model. Numerical example is presented to illustrate the proposed method.

Score prediction using old databases in IPL

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Presently the projected score in $1st$ innings of a cricket match at a particular instant is calculated by taking run rates into consideration. The theory was not able to show the real picture as it failed to take into account the quality of the batting team, the quality of the bowling attack and the pitch conditions of the match. In my theory I have formulated a technique to calculate the projections using past records of the teams and ground conditions as parameters. The model is based on the database of all IPL matches played between the 8 regular teams since April 2008. I have also designed an application for the same using DBMS software and JAVA Netbeans IDE 8.0.

ID-confinement theory of filters in bicomplex space

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In this paper, we have studied the structure of the filters on the bicomplex space C_2.We have discussed the ID-confinement of the filters in the order topologies on C_2 defined by us earlier. We have established the relations between bicomplex nets and their associated filters on C_2 & vice-versa. We have also studied the clustering of the bicomplex filters in different ID-zones. We have also defined the product of filters on the

bicomplex space and studied it.

Some fixed point results in fuzzy metric spaces using a control function

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In this paper, we establish the results on existence and uniqueness of fixed point for Φ-contractive and generalized C-contractive mapping in the fuzzy metric space in the sense of George and Veeramani satisfying the condition $sup_{(0<a<1)}\{T(a,a) : a < 1\} = 1$. We use the notion of altering distance for proving the results.

An exponential estimation procedure in two-occasion successive sampling under the occurrence of non-response

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The present work suggests exponential method of estimation of current population mean in two occasion successive sampling when non response occurs only on first occasion. Using sub sampling of non-respondents technique, exponential estimation procedure has been developed which utilizes the information on a dynamic auxiliary variable. Properties of the

proposed estimation procedure have been examined and related optimum replacement strategy is suggested. Empirical studies are carried out and results are interpreted to evaluate the performances of the proposed estimator. Suitable recommendations have been made.

Compromised imputation methods of missing data for estimating the population mean in survey sampling

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The present work suggests some compromised methods of imputation to lessen the impact of non-response in the survey data due to various assignable factors in survey sampling. The suggested imputation methods lead to the exponential type estimators of population mean of study variable. The bias and the mean square errors of the resultant estimators are derived up to the first order of approximations and their properties are studied. Empirical studies are carried out to show that the resultant estimators outperform the usual mean and ratio method of imputation in terms of the mean square error criterion.

Estimation of population mean under non-response in H-occasion successive sampling

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This paper presents a general estimation procedure of population mean when non-response occurs in h-occasion successive sampling. Estimation procedure has been suggested with the aid of information on a stable auxiliary variable which is readily available on all occasions. Properties of the suggested estimation procedure have been examined and empirical studies are carried out to validate the performance of estimates. Suitable recommendations have been made.

I: No abstract received

J: Operations Research

Duality for nondifferentiable minimax fractional programming problem involving higher order (C, α, ρ, d)-convexity

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In this paper, we present new class of higher-order (C, α, ρ, d)-convexity and formulate two types of higher-order duality for a nondifferentiable minimax fractional programming problem. Based on the higher-order (C, α, ρ, d)-convexity, we establish appropriate higher-order duality results. These results extend several known results to a wider class of programs.

K: Solid Mechanics, Fluid Mechanics, Geophysics and Relativity

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Mathematical design of vibration & shock isolation systems focusing automobile and aerospace applications

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This is an Industry-academia oriented presentation to highlight the design and selection of Vibration & Shock isolation Systems for Industrial Application. The Vibrations or Oscillations of periodic nature are implicitly connected with almost

everything starting from Atoms & Molecules to the orbital motion of gigantic planets studied in Astrophysics & Astronomy. The Shock is defined as an event in space and hence it requires a fourth dimension of time in addition to space coordinates to define a shock pulse. For industrial calculation the input shock is defined as half sine, Triangular or rectangular pulse in terms of acceleration 'g' and time duration in milli-seconds (ms) for studying the response of shock on mechanical systems or electronic modules, mounted in an aircraft or an aerospace vehicle. The requirement of isolation systems for the landing shock of an aircraft and the lift off & stage separation of a multistage rocket or space vehicle will be explained. By using optimized Vibration and shock isolation systems the force transmission may be reduced substantially which in turn will protect the instruments from severe damage. The mathematical design concepts and the effective reduction in shock transmission achieved by using nonlinear systems will be discussed.

Effect of rigid boundary on torsional surface waves in an inhomogeneous layer over a gravitating anisotropic porous half-space

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The present work aims to deal with the propagation of torsional surface wave in an inhomogeneous layer over a gravitat-

ing anisotropic porous half space. The inhomogeneous layer exhibits the inhomogeneity of quadratic type. In order to show the effect of gravity the equation for the velocity of torsional wave has been obtained. It is also observed that for a layer over a homogeneous half space without gravity, the torsional surface wave does not propagate. An attempt is also made to assess the possible propagation of torsional surface waves in that medium in the absence of the upper layer. The effects of inhomogeneity factors and porosity on the phase velocity are depicted by means of graphs.

Reflection of quasi-P waves in a self-reinforced medium

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The present paper is concerned with the reflection of quasi-P waves in a self-reinforced medium. Thevelocities of quasi-P and quasi-S waves in the self-reinforced medium have also been derived analytically. The closed form expressions of the reflection coefficients of reflected quasi-P and quasi-S waves have been obtained. From the numerical study, it has been noticed that the reflection coefficients depend on the direction of propagation. The results are in agreement with the classical case in the absence of reinforcement. The reflection coefficients of the reflected quasi-P and quasi-S waves are calculated numerically and are presented by means of graphs.

Reinforcement to the security force in a counter insurgency operation involving range-dependent attrition-rate coefficients

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A sharp increase in incidences of insurgency like Naxalites' activity and terrorism in the recent times in both rural and urban areas is becoming a matter deep concern to all over the world. Security force engaged in a counter insurgency operation faces many major problems like identification of insurgents and their ultimate captive/ destruction because of insurgents' freedom of movement. Sometimes in a counter insurgency operation security force is outnumbered to insurgents due to the frequent change in strategies of insurgents. Therefore, reinforcement to the outnumbered security force is significant to minimise casualties and to finish that operation within a stipulated time frame.

In this paper, a conceptual model dealing with certain operational factors like maximum effective range, break-point, is being discussed referring the concepts of Lanchester-type equations with range dependent attrition-rate coefficients to project the effectiveness of forces while showing the importance of reinforcement to the outnumbered security force at an early stage of combat operation and the strength of reinforcement by considering a case study.

Effect of moving punch in a viscoelastic medium

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The present work studies the effect of semi-infinite moving punch on the propagation of Love-type wave in a viscoelastic strip. Closed form expression of dynamic stress concentration due to the punch for the force of a constant intensity has been obtained. The study manifests the profound effect of various affecting parameters viz. speed of moving punch associated with Love-type wave speed, frequency parameter and viscoelastic parameter on dynamic stress concentration due to semi-infinite punch. These effects have been analyzed by means of graphical illustrations.

Propagation of edge wave in fibre-reinforced plate

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Fibre-reinforced materials are an extremely broad and versatile class of material, encompassing a wide range of fibre and matrix combinations that provide a multiplicity of component design and manufacturing options. Their high strength cou-

pled with light weight leads to their use wherever structural efficiency is at a premium. This motivated is to study the propagation of edge waves in an initially stressed fibre-reinforced plate. The present study deals with the propagation of edge wave in an initially stressed fibre-reinforced plate of finite thickness. The closed form expression of the frequency equation is obtained. Wave number, horizontal/vertical compressive initial stresses have their significant effect on the phase velocity.

SH-wave propagation in an intermediate irregular layer

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The current study deals with the possibility of propagation of SH-wave in a initially stressed irregular composite layer sandwiched between an upper initially stressed heterogeneous isotropic layer of finite width and lower initially stressed isotropic half-space. Comparative study has been made for the case when composite medium is present as an irregular sandwiched layer to the case when isotropic medium is present as an irregular sandwiched layer.

Torsional surface wave propagation in an intermediate viscoelastic layer

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This paper presents a theoretical study on propagation of torsional surface wave in a viscoelastic medium lying between two heterogeneous half-spaces in the presence of initial stress and gravity. The dispersion equation has been derived in a closed form using Whittaker's function and its derivative. It is found that there is a substantial effect of heterogeneity parameter, initial stress, Biot's gravity parameter and sandy parameter on the phase velocity of torsional surface wave.

L: Electromagnetic Theory, Magneto-Hydrodynamics Astronomy and Astrophysics

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Rotationally symmetric viscous flow over a rough rotating disk

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The flow due to uniform rotation of a viscous fluid at a larger distance from an infinite rotating disk is investigated numerically. The conventional no-slip boundary conditions are replaced by partial slip boundary conditions. As closed form analytical solution does not exist, an effective second order numerical scheme has been adopted. The resulting system of fully coupled, nonlinear similarity equations are integrated accurately for full range of flow parameters. Effects of wall roughness on the boundary layer are discussed with relevant physical interpretations. It is observed that for $s > 1$, the velocity profiles resemble those of Karman flow and for $s < 1$, the profiles resemble those of Bodewadt flow. Heresis the ratio of the disk's angular speed to that of the rigidly rotating fluid far from it.

Unsteady MHD free convection and mass transfer of a dusty visco-elastic fluid through a porous medium

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The present paper deals with unsteady free convection and mass transfer of a incompressible, electrically conducting, viscoelastic (Rivlin-Ericksen) fluid flowing through a porous medium bounded by an infinite vertical porous plate with constant heat flux. Expression for liquid velocity, particle velocity, and temperature filed and concentration field have been obtained following light hill [1]. Skin friction and heat flux have also been obtained. The result of Singh et al. [2] and Sahoo & Sahoo [3] have been deduced as particular cases of the present study.

Unsteady magneto-hydrodynamics dusty Oldroyd fluid flow through horizontal channel with energy dissipation

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A problem of unsteady two dimensional hydro-magnetic flow of dusty Oldroyd fluid in a horizontal channel has been studied in presence of volume fraction and energy dissipation. A magnetic field of strength B0 is applied along the transverse

direction to the plate. The channel is bounded by two parallel plates, the lower one is kept fixed but the upper one is oscillating with time about a non-zero constant mean. The fluid motion is governed by Saffman model and Oldroyd fluid model. Heat is generated by energy dissipation and it is absorbed by dust particles through conduction. The governing equations of motion are solved analytically and the results are discussed graphically/ numerically for various values of flow parameters involved in the solution.

Stratified visco-elastic fluid flow in a slip flow regime past a porous surface in presence of heat source/sink

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A steady stratified visco-elastic fluid flow past a porous plate in a slip flow regime has been investigated under the influence of heat source/ sink. The plate is subjected to a constant suction velocity. In this study, generalized boundary conditions for the slip flow regime at the plate are used. The mechanism of visco-elastic fluid flow contains both viscous and elastic responses and it is characterized by Walters Liquid (Model B?) for short relaxation memories. The governing equations are solved analytically by using perturbation technique. Velocity profile and temperature fields are presented graphically and shearing stress and Nusselt number (rate of heat transfer) are represented in tabular form for various values of flow param-

eters involved in the solution with special emphasis given on the effects of visco-elasticity and stratification.

Forced convective second grade fluid flow in a rotating system with hall effects

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The unsteady hydromagnetic forced convection flow of a second grade and electrically conducting fluid from an infinite horizontal porous plate with constant suction in presence of a transverse magnetic field has been studied. The entire system rotates with a constant angular velocity about the normal to the plate taking Hall current into account with energy dissipation. The governing equations are solved by using multi parameter-perturbation technique. The analytical expressions for the velocity, temperature field, skin friction, the rate of heat transfer at the plates in terms of Nusselt number have been obtained. The effects of visco-elastic parameter, on the velocity, temperature and skin friction, Nusselt number have been illustrated graphically, in combination with other flow parameters involved in the solution. The problem has some relevance in the geophysical and astrophysical studies.

On hydromagnetic flow of an Oldroyd-B fluid between two oscillating plates

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An initial value investigation is made of the motion of an incompressible, viscoelastic, electrically conducting Oldroyd-B fluid bounded by two infinite rigid non-conducting plates. The flow is generated impulsively from rest in the fluid due to rectilinear oscillations of given frequencies superimposed on the plates in their own planes in presence of an external magnetic field acting transversely to the plates. The operational method is used to derive exact solutions for the fluid velocity and the shear stress on the walls. The quantitative evaluation of the results is considered when two plates oscillate in phase but with different frequencies. The results are shown graphically for different time periods T_1 (lower plate) and T2(upper plate) of oscillations which represent the cases: (i) $T_1 < T_2$, (ii) $T_1 = T_2$ and (iii) $T_1 > T_2$. It is seen that the effect of fluid elasticity on the flow depends on T_1 and T_2. Further, the magnetic field damps the fluid motion for all values of the time periods. The shear stresses on both the plates are shown in all the cases. In the case (i), the stress on the lower plate decreases and becomes negative till the middle of T_1 which again increases towards the end and becomes large positive. Similar phenomenon also occurs for the case (iii). For the case (ii), the stress is found to be less effective. In all cases, the amount of shear stress on the plates increases with the elasticity of the fluid and decreases with the increase of the magnetic field. The steady-state solutions are also derived

and the thicknesses of the boundary layers are measured on both the plates. The flow in the non-oscillatory case is also derived. The classical and hydromagnetic solutions are derived as the special cases of the present analysis.

Geometry of Lissajous orbits in the Sun-Earth system with radiation pressure

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In this paper, we extend an existing approach to find the Lissajous orbits around Lagrangian point L_1 in the restricted three body problem with the Sun as radiating source and the Earth as the smaller primary. We analyze the effects of radiation pressure on the quasiperiodic orbits around Lagrangian point L_1. The geometry of Lissajous orbits classically and with radiation pressure are depicted in figures which is computed using Lindstedt-Poincare method upto third order approximation. Due to the effect of radiation pressure in the Sun-Earth system the size of the orbits around L_1 shrinks from the classical case.

Equilibrium points and their stability in exoplanetary systems with Yarkovsky effect

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In this paper we use the restricted three body problem in the presence of Yarkovsky effect to investigate dynamical behaviours of a small body in some exoplanetary systems (HD189733A-HD189733b, Kepler 68-Kepler 68d, Kepler 62-Kepler 62e, Gliese581-Gliese581d). Here, we consider bigger primary as a source of radiation, and compute the Lagrangian points. It is found that collinear points does not lie on the line joining two primaries. We have examined the linear stability of first collinear point L1and triangular point L_4 and it is found that L_1 and L_4 are unstable when Yarkovsky effect is considered but in the absence of Yarkovsky effect, L_4 is stable. In the presence of Yarkovsky effect trajectories and periodic orbits of the small body in the vicinity of equilibrium points L_1 and L_4 are studied. Also we have seen the result for Sun-Earth system around L_4 points.

Holographic reconstruction of scalar field dark energy model in anisotropic Bianchi type-II space-time

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In this paper, we study the correspondence between the quintessence energy density with the holographic dark energy in anisotropic Bianchi type II cosmological space-time. This correspondence allows reconstructing the quintessence potential and the dynamics of scalar field model, which describes the accelerated

expansion of the Universe. The exact solutions to the corresponding Einstein's field equations are obtained for variable deceleration parameter.

M: Bio-Mathematics

Almost periodicity of a delayed density dependent predator-prey system with mutual interference

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In this paper, we consider and study a delayed nonautonomous predator-prey system with mutual interference and Crowley-Martin functional response. Crowley-Martin functional response is similar to the Beddinton-DeAngelis functional response but contains an extra term describing mutual interference by predators at high prey density. We discuss the dynamics of the system mainly from the point of view of permanence, extinction, stability, existence and uniqueness of a globally attractive almost periodic solution by applying comparison theorem of differential equations and constructing a

suitable Lyapunov functional. The analytical results obtained in this paper are illustrated with a numerical example.

Enhancing Synchrony in chaotic oscillators by dynamic relaying

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In a module of three coupled oscillators, the critical coupling of complete synchronization in two identical outer oscillators' decreases when a parameter mismatch is induced in the central oscillator. Outer oscillators interact indirectly via dynamic relaying mediated by the mismatched oscillator in absence or presence of coupling delay. This enhancing effect is observed in many dynamical systems and also in 1D arrays of oscillators. We provide numerical evidences using Lorenz system, Rossler system, Hindmarsh-Rose neuron model, time delay Mackey-Glass system and experimental support as well in electronic circuit.

Analysis on stability of periodic points, period doubling bifurcation and Lyapunov exponent in a chaotic model

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In this paper we consider a nonlinear algebraic mathematical model
$f(x) = \mu x e^{((-c/v)x)}$ with μ as an adjustable parameter which is modified form of "Ricker Population Model". With the help of programming in MATHEMATICA it has been observed that the map follows a period doubling route to chaos. Further in order to establish a universal route from order to chaos through period doubling bifurcations we built up appropriate numerical methods to obtain periodic points and bifurcation points of different periods $2^0, 2^1, 2^2, 2^3, 2^4, ...$ and find Feigenbaum Universal Constant(δ) =4.66919867 Again with the help of bifurcation points and Feigenbaum delta, the accumulation point is calculated numerically. We confirm the chaotic nature of the model through Schwarzian derivatives which is found to be negative, and chaotic region has also been confirmed by obtaining positive Lyapunov Exponents at suitable parametric values.

Fractals: The language of nature

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The aim of the present article is to describe Fractals and its inherent applications in the varied field of knowledge.

N: History and Teaching of Mathematics

All the newly invented theorems on plane geometry

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It is well known all over the world by most of the scientists and Mathematicians that (1) Trisection of an random angle, (2) Squaring a circle and (3) Doubling a cube are the three Ethic Problems of mathematics and are remained unsolved for about 3,000 (three thousand) years or so.The problem of squaring a circle has been expressed as the most difficult one amongst the above mentioned three problems by one Fernandis Lindemann in the year 1882.

Yet, while trying to solve the first two problems mentioned above some of new results are found which could be expressed

in the form of NEW THEOREMS of Plane Geometry. Hence, the Six New Theorems are INVENTED and most graciously it is to mention here that out of the six New Theorems the sixth Theorem helps to draw a square ABSOLUTELY EQUAL in area to the area of a given (random) circle irrespective of the uncertain value of π (pi). According to this theorem, the use of π is not required to draw a square equal in area to the area of a given circle.

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