

## ACADEMIC REPORT

### About IWM

Indian Women and Mathematics (IWM) is a collective of Indian mathematicians that has been in existence since 2009. Our objective is to encourage more women to pursue higher education in mathematics, and to organize events and networking opportunities that will enable them to take up careers in mathematics.

The IWM Annual Conferences aim to bring together women students, college and university teachers and early-career researchers with mathematicians, especially women mathematicians **not just from India but internationally**, working at the frontiers of mathematics, to exchange mathematical ideas and share their experiences.

A major goal of these events is to enable junior women mathematicians to interact with their senior colleagues, both individually and in small groups, as well as to present their own work. To this end, in addition to the invited talks, there are sessions featuring contributed talks, and a poster session. Advanced Ph.D. students and early-career researchers are encouraged to give a contributed talk or present a poster. Participation is *not* restricted to women only. Others are welcome to apply, especially those in the early stages of their careers.

For more information on IWM please visit the website <https://sites.google.com/site/iwmmath>.

### The 2018 Annual Conference

The 2018 Annual Conference was held at Shiv Nadar University, in the National Capital Region, during June 21-23. It was sponsored by the National Board for Higher Mathematics. Significant financial support was also received from the Committee for Women in Mathematics (CWM) of the International Mathematical Union. The CWM support enabled us to reach out to neighbouring countries and, for the first time, the conference had a delegation of 6 women mathematicians from **Nepal**. The total number of registered participants in the conference was 85. These came from all parts of India.

The program of the conference featured 4 **plenary talks**, 4 **invited talks**, 4 **talks by young mathematicians**, 12 **contributed talks**, a **poster session**, and a **mini-course on knot theory**. There was also a **panel discussion** on “*Indian Women and Mathematics-looking behind and the road ahead*”.

The **Scientific Committee** of the conference consisted of Gautam Bharali (Indian Institute of Science), Priyanka Grover (Shiv Nadar University), Amber Habib (Shiv Nadar University), Riddhi Shah

(Jawaharlal Nehru University), Sachi Srivastava (University of Delhi), and Geetha Venkataraman (Ambedkar University Delhi).

The members of the **Organizing Committee** were Neha Gupta, Amber Habib, Sneha Lata, Satyanarayana Reddy, Charu Sharma (all from Shiv Nadar University) and Geetha Venkataraman (Ambedkar University Delhi).

## Invited Contributions

### Plenary Talks:

| Speaker            | Affiliation                            | Title  |
|--------------------|--|--|
| Neela Nataraj      | IIT Bombay                             | Finite element methods: Research in India over last decade                           |
| Madhu Raka         | Panjab University                      | Recent Developments on Conjectures of Woods and Minkowski                            |
| R. Parimala        | Emory University                       | Quadratic forms and Clifford algebras  |
| Vijaylaxmi Trivedi | Tata Institute of Fundamental Research | Hilbert-Kunz Invariants, with Applications to Semistability, Tiling and F-thresholds |

### Mini-Course:

A mini-course of 3 lectures on **Knot Theory and Quantum Groups** was delivered by Dr Rama Mishra, IISER Pune.

### Invited Talks:

|                    |                      |   |
|--------------------|----------------------|---|
| Nikita Agarwal     | IISER Bhopal         | Stability of Switched Dynamical Systems   |
| Sujata Ghosh       | ISI Chennai          | Formal studies of strategic reasoning   |
| Jyotshana Prajapat | University of Mumbai | Some problems in potential theory and free boundaries   |
| Anuradha Sharma    | IIT Delhi            | On the structure and distances of repeated-root constacyclic codes of prime power lengths over finite commutative chain rings |

### Talks by Young Mathematicians:

|                  |                                      |   |
|------------------|--------------------------------------|---|
| Ananya Lahiri    | Chennai Mathematical Institute       | Asymptotic properties of the volatility estimator from high-frequency data modelled by mixed fractional Brownian motion |
| Purvi Gupta      | Rutgers University                   | Polynomial density on compact real manifolds  |
| Shreedevi Masuti | Chennai Mathematical Institute       | On the Waring problem for binary forms  |
| Vandana Rajpal   | Shivaji College, University of Delhi | $\lambda$ -theory of operator spaces  |

### Panel Discussion on “Indian Women and Mathematics-looking behind and the road ahead”:

The panellists were: Riddhi Shah (Jawaharlal Nehru University), Gautam Bharali (Indian Institute of Science), Priyanka Grover (Shiv Nadar University), Purvi Gupta (Rutgers University), Amber Habib (Shiv Nadar University). The panel initiated a discussion on the outcomes so far of the IWM project, the need to continue, obstacles faced in the journey, and possibilities for the future.

## Participants from Nepal

The IWM project has started to network with mathematicians from neighbouring countries such as Bangladesh and Nepal, and we have participated in activities in Nepal. The 2018 Annual Conference featured a delegation of mathematicians from Nepal, who also gave talks and presented posters:

|                    |                      |                  |
|--------------------|----------------------|------------------|
| Dhana Kumari Thapa | Tribhuvan University | Contributed Talk |
| Saraswati Acharya  | Kathmandu University | Contributed Talk |
| Anjana Pokharel    | Tribhuvan University | Poster           |
| Sharmila Shreshtha | Kathmandu University | Poster           |
| Sarala Luitel      | Tribhuvan University |                  |
| Tara Paudel        | Tribhuvan University |                  |
| Prakriti Dhakal    |                      |                  |

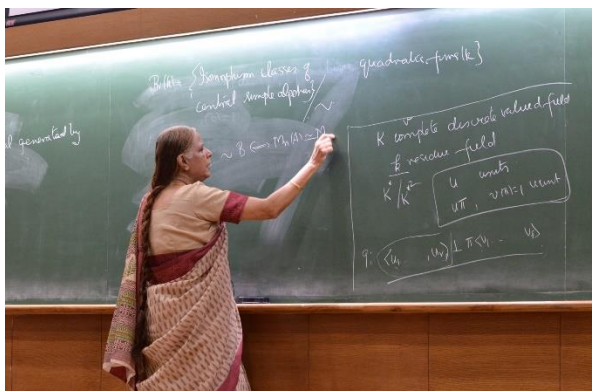
## Images



Plenary Lecture by Neela Nataraj



Plenary Lecture by Vijaylaxmi Trivedi



Plenary Lecture by R Parimala



Mini-course by Rama Mishra

## IWM 2018-SCHEDULE OF TALKS

|                          |  |                                |                             |  |  |                                     |  |  |              |                     |
|--------------------------|--|--------------------------------|-----------------------------|--|--|-------------------------------------|--|--|--------------|---------------------|
| 9:00-9:30                | 9:30-10:00                             | 10:00-11:00                    | 11:00-11:30                 | 11:30-12:30                            | 12:30-13:05                                | 13:05-14:30                         | 14:30-15:15                                | 15:15-15:55  | 15:55-16:25  | 16:25-17:40         |
| Registration             | Inauguration                           | Plenary talk-<br>Neela Nataraj | Tea                         | Mini course-<br>Rama Mishra            | Young mathematician-<br>Purvi Gupta        | Lunch                               | Invited talk-<br>Anuradha Sharma           | Contributed talks (3 sessions, 2 talks each)<br>Parallel Session I-<br>Preeti, Sheela Verma<br>Parallel session II-Jyoti Singh,<br>Dishari Chaudhuri<br>Parallel<br>Session III-Charu Sharma, A.<br>Karthika   | Tea & Poster | Panel<br>discussion |
|                          |  |                                |                             |  | <u><a href="#">DAY 2-June 22, 2018</a></u> |                                     |  |  |              |                     |
| 9:00-10:00               | 10:00-10:45                            | 10:45-11:15                    | 11:15-12:30                 | 12:30-13:05                            | 13:05-14:30                                | 14:30-15:30                         | 15:30-16:15                                | 16:15-17:15  |              |                     |
| Plenary talk-Madhu Raka  | Invited talk-<br>Jyotshana<br>Prajapat | Tea                            | Mini course-<br>Rama Mishra | Young mathematician-<br>Ananya Lahiri  | Lunch                                      | Plenary talk-<br>Vijaylaxmi Trivedi | Poster Session & Tea (Tea starts at 15:45) | Contributed talks (3 sessions, 3 talks each)<br>Parallel Session I-Isha Garg, Anchal Aggarwal ,<br>Monimala Nejj Parallel<br>Session II-Lachit Bora,<br>Neha Agarwal, Pinkimani Goswami Parallel<br>session III-, Parbati Sahoo, Saraswati Acharya, Shivangi Asthana |              |                     |
|                          |  |                                |                             |  | <u><a href="#">DAY 3-June 23, 2018</a></u> |                                     |  |  |              |                     |
| 9:00-10:00               | 10:00-10:45                            | 10:45-11:15                    | 11:15-12:30                 | 12:30-13:05                            | 13:05-14:30                                | 14:30-15:15                         | 15:15-15:50                                | 15:50-16:20  | 16:20        |                     |
| Plenary talk-R. Parimala | Invited talk-<br>Nikita Agarwal        | Tea                            | Mini course-<br>Rama Mishra | Young mathematician-<br>Vandana Rajpal | Lunch                                      | Invited talk-Sujata Ghosh           | Young mathematician-Shreedevi Masuti       | Valedictory function   | Farewell Tea |                     |

## Abstracts

### PLENARY TALKS

**Speaker:** Neela Nataraj (IIT Bombay)

**Title:** Finite element methods: Research in India over last decade

**Abstract:** In this talk, some major contributions of Indian mathematicians to the mathematical aspects of the finite element method in the last one decade will be outlined. A brief description of the method itself is provided so that the talk is accessible to anybody with a background in partial differential equations and numerical techniques for solving it. We will then focus on some of our recent contributions to the area that include FEM for nonlinear plate bending problems and distributed optimal control problems governed by plate bending problems.

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**Speaker:** Madhu Raka (Punjab University)

**Title:** Recent developments on Conjectures of Woods and Minkowski

**Abstract:** In Geometry of Numbers, there is a longstanding classical conjecture of Minkowski on the product of  $n$  non-homogeneous linear forms. In this talk I will deliberate upon the history of the conjecture, different approaches tried to solve it including the approach via Woods Conjecture. I will also discuss some developments on these conjectures during the last decade. The conjectures are settled for  $n \leq 9$  only.

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**Speaker:** Vijaylaxmi Trivedi (TIFR Mumbai )

**Title:** Hilbert-Kunz invariants, with applications to semistability, tiling and F-thresholds

**Abstract:** We give a brief survey of Hilbert-Kunz multiplicities and density functions. These are characteristic  $p$  singularity invariants for commutative Noetherian rings. The HK density function is a compactly supported continuous function and was introduced to study the numerical invariant  $e_{HK}$  (HK multiplicity).

This idea of replacing a number ( $e_{HK}$ ) by a function (HK density) seems to be an effective technique to handle the notoriously difficult invariant  $e_{HK}$ .

On the other hand the HK multiplicity characterizes seemingly unrelated invariants like Frobenius semistability of the vector bundles over curves, F-thresholds for curves and the tiling property of rational convex polytopes.

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**Speaker:** R. Parimala (Emory University, USA)

**Title:** Quadratic forms and Clifford algebras

**Abstract:** Let  $k$  be a number field. Class field theory enables us to understand the Brauer group of  $k$ . The Clifford algebras of quadratic forms define classes in the Brauer group of  $k$  which are classes of quaternion algebras. Further Hasse--Minkowski theorem leads to the fact that every 5-dimensional indefinite quadratic form over  $k$  has a nontrivial zero. In this talk, we explain how over a general field of characteristic not 2, Clifford algebras play a central role in determining whether quadratic forms in large enough number of variables admit a nontrivial zero.

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### MINI-COURSE

**Title:** Knot Theory and Quantum groups

**Speaker:** Rama Mishra (IISER Pune)

**Abstract:** In this mini course I will provide exposure to research in knot theory and talk about the basic philosophy behind constructing knot invariants. It will be shown that in the process, certain quantum groups naturally arise. I will elaborate on Quantum groups in general and show how their representations lead to constructing knot invariants.

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### INVITED TALKS

**Title:** On the structure and distances of repeated-root constacyclic codes of prime power lengths over finite commutative chain rings

**Speaker:** Anuradha Sharma (IIIT Delhi)

**Abstract:** Let  $p$  be a prime,  $s$  be a positive integer, and let  $\mathcal{R}$  be a finite commutative chain ring with the characteristic as a power of  $p$ . For a unit  $\lambda \in \mathcal{R}$ ,  $\lambda$ -constacyclic codes of length  $p^s$  over  $\mathcal{R}$  are ideals of the quotient ring  $\mathcal{R}[x]/\langle x^{p^s} - \lambda \rangle$ . We derive necessary and sufficient conditions under which the quotient ring is a chain. When  $\mathcal{R}[x]/\langle x^{p^s} - \lambda \rangle$  is a chain ring, all  $\lambda$ -constacyclic codes of length  $p^s$  over  $\mathcal{R}$  are known. We establish algebraic structures of all  $\lambda$ -constacyclic codes of length  $p^s$  over  $\mathcal{R}$  when  $\mathcal{R}[x]/\langle x^{p^s} - \lambda \rangle$  is a non-chain ring. We also determine the number of codewords in each of these codes. Using their algebraic structures, we obtain Hamming distances, b-symbol distances, Rosenbloom-Tsfasman (RT) distances, and Rosenbloom-Tsfasman (RT) weight distributions of all constacyclic codes of length  $p^s$  over  $\mathcal{R}$ ; where  $2 \leq b < p^s$ . Apart from this, we derive necessary and sufficient conditions under which a constacyclic code of length  $p^s$  over  $\mathcal{R}$  is maximum-

distance separable (MDS) with respect to the (i) Hamming metric, (ii) b-symbol metric, and (iii) Rosenbloom-Tsfasman (RT) metric. We also provide an algorithm to decode constacyclic codes of length  $n$  over  $\mathcal{R}$ .

This is a joint work with my PhD student, Ms. Tania Sidana.

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**Title:** Some problems in potential theory and free boundaries

**Speaker:** Jyotshana Prajapat (University of Mumbai)

**Abstract:** I will introduce some problems, solved as well as open, in topics of potential theory and related to free boundary problems. Some symmetry results will also be discussed.

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**Title:** Stability of Switched Dynamical Systems

**Speaker:** Nikita Agarwal (IISER Bhopal)

**Abstract:** A continuous-time switched system is a piecewise continuous dynamical system with finitely many subsystems, and a piecewise constant function, known as the switching signal, which determines the switching of the system between subsystems. A signal is represented by the admissible switching from one subsystem to another, and the times at which these switchings take place. In this talk, the switching between subsystems will be governed by an underlying digraph. That is, the system can switch from a subsystem to another if there is a directed edge between the corresponding vertices on the underlying graph.

Even when all the subsystems are stable, the switched system may be unstable for some switching signal. Moreover, one can construct a signal which can stabilize a switched system with all unstable subsystems. Thus, it is evident that the stability of a switched system not only depends on the properties of subsystems, but also on the switching signal. In this talk, we will discuss some sufficient conditions on the switching times under which the switched system will be stable. We will introduce a novel concept of simple loop dwell time and use it to derive these sufficient conditions for stability. This approach is an improvement over other notions such as dwell time and average dwell time which are popularly used to derive sufficient conditions for stability. Further this approach will give rise to a slow-fast switching mechanism which is effective and useful for application purposes.

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**Title:** Formal studies of strategic reasoning

**Speaker:** Sujata Ghosh (ISI Chennai)

**Abstract:** In addition to 'real' games like chess and bridge, strategies play out in many different areas of life. As such, the study of strategic reasoning in games has become an integral part of many areas of science. After providing a brief overview of these relevant areas, the talk will focus on a particular kind of games, namely dynamic games, and discuss certain formal investigations of these games from the viewpoints of logic and game theory.

The talk will not assume any prior knowledge of logic or game theory.

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## TALKS BY YOUNG MATHEMATICIANS

**Title:** Polynomial density on compact real manifolds

**Speaker:** Purvi Gupta (Rutgers University, USA)

**Abstract:** In this talk, we will discuss some questions regarding the minimum embedding (complex) dimension of abstract compact (real) manifolds conditional on certain approximation-theoretic considerations. The primary challenge comes from the so-called CR-singularities of an embedding. We will discuss why this is the case, and how they can be dealt with in certain dimensions.

This is a joint work with R. Shafikov (UWO, Canada).

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**Title:** Asymptotic properties of the volatility estimator from high-frequency data modelled by mixed fractional Brownian motion

**Speaker:** Ananya Lahiri (CMI)

**Abstract:** Properties of mixed fractional Brownian motion (MFBM) has been discussed by Cheridito (2001) and Zili (2006). We have proposed an estimator of volatility parameter for a model driven by MFBM. Model is essentially geometric mixed fractional Brownian motion if we can name it so. The motivation for this model is from a paper by Sun L. (2013). We have considered

the estimator of the volatility parameter from high-frequency data. In our article, we have shown that this estimator of the volatility parameter has some desirable asymptotic properties, namely strong consistency, asymptotic normality. We have also calculated Barry Esseen bound and provided with some simulation studies to support our findings.

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**Title:**  $\lambda$ -theory of operator spaces

**Speaker:** Vandana Rajpal (DU)

**Abstract:** We extend the  $\lambda$ -theory of operator spaces given in Defant and Wiesner (J. Funct. Anal. 266(9): 5493-5525, 2014), that generalizes the notion of the projective, Haagerup and Schur tensor norm for operator spaces to matrix ordered spaces and Banach  $*$ -algebras. The ideal structure of  $\lambda$ -tensor product of  $C^*$ -algebras has also been discussed.

This is a joint work with Ajay Kumar and Preeti Luthra.

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**Title:** On the Waring problem for binary forms

**Speaker:** Shreedevi Masuti (CMI)

**Abstract:** It is well-known that every homogeneous polynomial with coefficients in the field of complex numbers can be written as a sum of powers of linear forms. Given a form  $F$ , the Waring problem asks for the minimal number of summands needed for such an expression of  $F$ . In this talk we will discuss the Waring problem for binary forms.

This is my joint work with Laura Brustenga.

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## CONTRIBUTED TALKS

**Title:** A Note on Lindelöf Spaces

**Speaker:** A. Karthika (SriKrishna College of Eng. and Tech., Tamil Nadu)

**Abstract:** The aim of this paper is to obtain the characterizations of Lindelöf spaces with respect to grill. We also introduce the G-regular and G-normal spaces in grill topological spaces and exhibit the relationship among them.

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**Title:** Contractive maps on operator ideals and norm inequalities III

**Speaker:** Anchal Aggarwal (Sant Longowal Inst. of Eng. and Tech.)

**Abstract:** Let  $(I, ||| \cdot |||)$  be a norm ideal of operators equipped with a unitarily invariant norm  $||| \cdot |||$ . We discuss some generalized Lyapunov type norm inequalities for operators, which are motivated by the work of Bhatia and Drissi, Hiai and Kosaki and JociÅ. We exploit integral representations and series expansions of certain functions to prove that certain ratios of linear operators acting on operators in  $I$  are contractive. This leads to several new and old norm inequalities for operators which were earlier in the matrix settings.

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**Title:** Uncovering the network amongst the stocks returns by studying the non-linear interactions in high frequency data of the Indian Stock Market

**Speaker:** Charu Sharma (SNU)

**Abstract:** We explore the detection of clusters of stocks that have similar properties and tend to move together in the Indian Stock Market. We have based our study on high frequency data for the year 2014. This was a year when general elections happened in India, and thus we have verified that the "stronger network connections" remained unaffected by the elections. We have used functional and nonlinear variants of principal component analysis, FPCA and KPCA. The nonlinear methods resulted in establishing stronger networks in comparison to linear methods. Of the two prominent clusters that showed up in our analysis, one corresponded to the banking sector and another to the IT sector. The cluster corresponding to banking sector emerged as an isolated, standalone cluster, which remain unaffected even during the election periods. The other smaller clusters found are from the automobile industry and the energy sector. Inter cluster interactions were also observed. The learning gained from these interactions is substantial as one can exploit this insight in developing trading strategies for intraday traders.

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**Title:** Some Aspects in Complex Dynamics

**Speaker:** Dhana Kumari Thapa (Tribhuvan University, Nepal)

**Abstract:** Complex Dynamics is considered as an interesting subject of theory and application. My presentation aims reviewing some aspects in complex dynamics.

**Title:**  $(\sigma, \tau)$ -Derivations of Integral Group rings

**Speaker:** Dishari Chaudhuri (IISER Mohali)

**Abstract:** A result due to E. Spiegel (Comm. Algebra, Vol. 22, pg. 2955-2959, 1994) says that every derivation of an integral group ring of a finite group is inner. An extension of this result to  $(\sigma, \tau)$ -derivation of an integral group ring of a finite group will be presented. The work has been communicated. Details can be found in <https://arxiv.org/pdf/1803.09418.pdf>.

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**Title:** Positivity properties of some non-negative matrices

**Speaker:** Isha Garg (NIT Jalandhar)

**Abstract:** In the present talk, we will discuss positivity properties of matrices  $[f(p_i + p_j)]$  and  $[f(p_i - p_j)]$  where  $f$  is a non-negative operator concave or operator convex function on  $[0, \infty)$  and  $p_1, p_2, \dots, p_n$  are distinct positive real numbers. The results for these matrices for power function  $t^r$  on  $[0, \infty)$  for  $r > 0$  are proved by Bhatia and Jain in 2015 and Dyn, Goodman and Michelli in 1986. Our results generalize these results and lead to many known and new results.

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**Title:** Derived functors of Graded local cohomology modules

**Speaker:** Jyoti Singh (Visvesvaraya National Institute of Technology, Nagpur)

**Abstract:** Let  $R = [X_1 \dots, X_n]$ , where  $K$  is a field of characteristic zero and  $R$  is standard graded. Let  $m = (X_1, \dots, X_n)$  and let  $E$  be the \*injective hull of  $R/m$ . Let  $A(K)$  be the  $n$ th Weyl algebra over  $K$ . If  $T$  is graded Lyubeznik functor on  $*Mo(R)$ , then we show that  $T(R)$  is generalized Eulerian  $An(K)$  module. As an application, we show that  $H_m^i T(R) \cong E(n)^{a_i}$  for some  $a_i \geq 0$ .

(This is the joint work with Prof. Tony J. Puthenpurakal, IIT Bombay).

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**Title:** On Selmer group of certain admissible extensions

**Speaker:** Lachit Bora (JNU)

**Abstract:** Selmer group of an elliptic curve has been object of study for a long time. We investigate the dual Selmer group for a certain admissible extension namely the compositum of the so-called  $GL_2$ -extension and the anticyclotomic extension of an imaginary quadratic number field over the Iwasawa algebra of the Galois group of this extension. This is a part of our thesis in preparation.

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**Title:** Exponents of primitive symmetric companion matrices

**Speaker:** Monimala Nej (SNU)

**Abstract:** In this paper, we found:

- (i) total number of primitive and imprimitive symmetric companion matrices.
  - (ii) the exponent set for the class of primitive symmetric companion matrices. More generally we found exponent of every primitive symmetric companion matrix.
  - (iii) the number of primitive symmetric companion matrices with a given exponent for certain cases.
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**Title:** Synchronization of a new asymmetric fractional order hyper chaotic system using adaptive control.

**Speaker:** NEHA AGRAWAL (DU)

**Abstract:** In this paper we have introduced a new fractional order hyperchaotic system and investigated its chaos synchronization using adaptive control technique.

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**Title:** Wormholes in  $R^2$ -gravity within the  $f(R, T)$  formalism

**Speaker:** Parbati Sahoo (BITS Pilani, Hyderabad)

**Abstract:** We propose, as a novelty in the literature, the modelling of wormholes within the particular case of the  $f(R, T)$  gravity, namely  $f(R, T) = R + \alpha R^2 + \lambda T$ , with  $R$  and  $T$  being the Ricci scalar and trace of the energy-momentum tensor, respectively, while  $\alpha$  and  $\lambda$  are constants. Although such a functional form application can be found in the literature, those concern to compact astrophysical objects, such that no wormhole analysis has been done so far. The quadratic geometric and linear material corrections of this theory makes the matter content of the wormhole to remarkably be able to obey the weak, null and dominant energy conditions.

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**Title:** A new example of Pseudo-free group

**Speaker:** Pinkimani Goswami (USTM)

**Abstract:** Most of the existing public key cryptosystems are based on the intractability of certain mathematical problems such as integer factorization problem, discrete logarithm problem etc. Many of those problems involve computations in a group and have the common property that they can become completely unsolved if the corresponding group is replaced with a free group. So, instead of making assumption that such-and-such problem is difficult to solve in a group, one can say once and for all that the given group is difficult to distinguish from a free group. Such a group is called pseudo-free group. The RSA group  $Z_N$ , where  $N$  is the product of two safe primes is the only known example of pseudo-free group and it is an interesting problem to find another example of pseudo-free group. In this article, we have given a new example of pseudo-free groups.

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**Title:** Operator system tensor products and  $C^*$ -envelopes

**Speaker:** Preeti (Delhi University)

**Abstract:** The relationship between an operator system and its  $C^*$ -envelope is a mysterious one. We discuss the topic of tensor product of operator systems and characterization of some structural properties of operator systems via canonically associated  $C^*$ -envelopes. This talk is based on my doctoral thesis.

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**Title:** The Effects of Sex and Menstrual Cycle Phases on Human Temperature Distribution

**Speaker:** Saraswati Acharya (Kathmandu University, Nepal)

**Abstract:** The paper deals implication of Pennes bio-heat equation by considering the suitable physical and physiological parameters of human body relying on dermal thickness of males and females for temperature distribution on the layers of dermal part. The mathematical model involving bio-heat equation has been solved using finite element method and Crank-Nicolson technique to numerically investigate two dimensional temperature distributions. Initially, human dermal region under consideration is divided into six parts: stratum corneum,

stratum germinativum, papillary region, reticular region, fatty layer and muscle part of subcutaneous tissue.

The results delineate tissue temperature distribution during follicular and luteal phases of females. The study is further carried out for the temperature distribution results of these phases as compared to males temperature distribution. The analysis presents that during the luteal phase of females, the tissue temperature is lower as compared to males when atmospheric temperature  $T$  falls below body core temperature. Likewise, females luteal phase temperature is slightly higher as compared to males when  $T$  exceeds body core temperature. But females follicular phase temperature is lower as compared to females luteal phase and males body temperature either  $T$  is greater or less body core. The above differences of females compared to males under same atmospheric conditions may be the causes of females hormonal variation during the menstrual cycle phases.

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**Title:** On Eigenvalue problem related to the Laplacian in a class of doubly connected domains

**Speaker:** Sheela Verma (IIT Kanpur)

**Abstract:** In this work, we consider two eigenvalue problems on some specific doubly connected domain.

First we consider the Steklov-Dirichlet eigenvalue problem on punctured domain (a smaller ball is take out from a bigger ball) and prove that the first eigenvalue of this problem attains its maximum only if balls are concentric.

Next we study Neumann eigenvalue problem on a punctured geodesically symmetric domain and prove that the first non-zero Neumann eigenvalue attains its maximum for annular domain.

This work is being sent for publication.

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**Title:** METHODS TO SOLVE DIOPHANTINE EQUATIONS

**Speaker:** SHIVANGI ASTHANA (NORTH EASTERN HILL UNIVERSITY)

**Abstract:** In this paper our main aim is to highlight the different methods used to solve Diophantine Equations.

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