Report on Ganita Sammelan

(The Annual ISHM Conference for the year 2024, jointly organized with IIT Gandhinagar during January 19-22, 2025)

1 Introduction

The Ganita Sammelan, held from 19th to 22nd January 2025 at IIT Gandhinagar, served as a vibrant confluence of scholars, educators, and enthusiasts exploring the rich heritage of Indian mathematics. Organized under the aegis of the History of Mathematics in India (HoMI) Project, with the support of Indian Society of History of Mathematics, and the IKS Division of the Ministry of Education, the event provided an engaging platform to discuss India's pioneering contributions to mathematical sciences. With an array of keynote addresses, panel discussions, and technical presentations, the conference bridged the historical evolution of mathematics with contemporary research and pedagogy, fostering interdisciplinary dialogue, and vibrant interactions of young scholars working in different areas of history of mathematics with senior researchers.

One of the special features of this years' ISHM conference was to organise a session exclusively devoted to pay tribute to Prof. RC Gupta who passed away on September 5, 2024. This session which was held on the forenoon of Day 3 of the conference paid homage to Prof R C Gupta, a renowned historian of Mathematical Sciences by arranging talks as well as video clips that highlighted his personality, as well as the contribution to the history of mathematics, particularly in documenting and analyzing the development of mathematical ideas and practices in the ancient Indian context.

2 Day 1: January 19, 2025

2.1 Inauguration

The inaugural session began with the welcome speech delivered by Prof. Amit Prashant, Dean R&D, IIT Gandhinagar, followed by an insightful address by Prof. Michel Danino, who emphasized the significance of exploring India's mathematical heritage. This event was held in a large auditorium with hundreds of attendees from a variety of backgrounds from different parts of India.

Distinguished guests, including Prof. Rajat Moona, Director of IIT Gandhinagar, Prof. M.D. Srinivas, Chairman of the Centre for Policy Studies, Chennai, and Prof. Manjul Bhargava from Princeton University, delivered special addresses emphasizing India's immense contributions to the field. At the same time, they also

cautioned to remain vigilant and to exercise discernment and thereby safeguard being influenced by individuals who propagate exaggerated and unjustifiable claims, through social media – that has become free for all to share what they like. A momentous occasion of the inaugural session was the unveiling of three significant texts:

1. *Bṛhatsaṃhitạ* of Varāhamihira Vol I (new edition with Utpala's comm.)
2. *Gaṇitakaumudi* of Nārāyaṇa Paṇḍita Vol I (with translation and notes)
3. *Tantrasaṅgraha* of Nīlakaṇṭha Somayājī (revised and enlarged edition)

The volumes were introduced by Prof. K. Ramasubramanian from IIT Bombay, who succinctly brought out their academic and historical relevance.

2.2 Keynote Address

The keynote address was delivered by Prof. Manjul Bhargava, and eminent mathematician and Fields Medalist from the Princeton University. He spoke on the topic: *An Overview of Some of India's World-Changing Contributions to Mathematics*, highlighting India's profound impact on global mathematical advancements, presenting ten key contributions spanning ancient and modern times, showcasing their lasting influence on mathematical thought.

2.3 Plenary Talks 1 & 2

The first plenary talk was presented by Prof. Amartya Kumar Dutta on *Early Landmarks in Indian Algebra*, tracing the genesis of algebra in India and examining fundamental contributions by Brahmagupta and other scholars. The session connected ancient texts to contemporary algebraic thought, highlighting significant mathematical developments over time.

The post-lunch session featured a plenary talk by Prof. M.D. Srinivas on *Locating Indian Knowledge in Modern Libraries: Incorporating the Traditional Classification of Knowledge in India*. He proposed a national adaptation of the Dewey Decimal Classification system to better integrate traditional Indian knowledge systems, showcasing an extensive digital classification of over 22,000 texts.

2.4 Fun with Maths

A Fun and Games session curated by the Center for Creative Learning (CCL) team from IIT Gandhinagar engaged school children with mathematical games and activities, concluding the day with an exchange of ideas and reflections among participants over tea. Many of the conference delegates too participated in the event and got benefited by it.

[The Executive Council (EC) Meeting of the ISHM was held post Conference events on January 19, 2025 in the later part of the evening in the Guest House of IITGn, between 5.30 – 7.00pm.]

3 Day 2: January 20, 2025

3.1 Plenary Session

The day began with Prof. Ganti S. Murthy's presentation on *IKS-Related Activities*, where he provided an overview of initiatives by the IKS Division, emphasizing the integration of Indian Knowledge Systems into academic curricula and contemporary education. He also discussed upcoming IKS Schemes that are going to be announced soon that provide ample opportunities to apply for projects, fellowships, and so on that can be seamlessly taken up with interdisciplinary collaborations, by any institution across India.

3.2 Panel Discussion

The plenary talk was followed by an interesting panel discussion on *New Pedagogies for Mathematics at School*, moderated by Prof. Michel Danino. The panel, featuring Prof. Manjul Bhargava, Prof. M.D. Srinivas, Prof. Amartya Dutta, and Prof. K. Ramasubramanian, deliberated on the relevance of integrating classical Indian mathematical content and innovative pedagogical strategies into modern education. The discussion concluded with a lively Q & A session with the audience, wherein the challenges that are faced in integration was also subtly highlighted.

3.3 Plenary Talk 3

Prof. M.S. Sriram delivered a plenary talk on *Mathematics in Indian Astronomy Texts*, demonstrating how mathematical advancements in ancient India, particularly in trigonometry and calculus, were closely linked to astronomical studies. He provided examples from texts such as the *Aryabhaṭīya* and *Siddhantasiromani* to illustrate this connection.

3.4 Technical Presentations

The afternoon session featured six technical presentations, covering diverse topics including the *Uyirezhuttu* numeral system from Tamil astronomy by Prof. Ramanathan (IIT BHU), Jayadeva's 11th-century algorithm for Pell's equations by Sri Ragavasimhan (Switzerland), the conception of negative numbers in the commentary of Krishna Daivajna's by Dr. Lalitha Sarma (IIT Bombay), and discussion on the procedure of computation of eclipse computations by Dr. Aditya Kolachana (IIT Madras).

Prof. V. Ramanathan showcased the innovative encoding of lunar and almanac data through Tamil vowels in the *Uyirezhuttu* numeral system from Tamil astronomy. This system predates Sanskrit *Vākyakaraṇa* and highlights Tamil's unique contribution to astronomical computations. The presentation by Dr. Raghavasimhan Thirunarayanan entitled "Setting a Fly Against the Wind: Early Indian Algorithm for Solving Pell's Equations" highlighted Acharya Jayadeva's 11th-century algorithm for solving Pell's equations. This meta-algorithm, preserved through

commentary texts, remains a significant mathematical innovation explored further through modern computational techniques.

Prof. Frederick L. Coolidge in his talk "Mathematics and Numerosity: The Origin of Abstractive Thinking" examined how mathematical abstraction evolved, connecting numerosity to human cognitive development, analogical reasoning, and metaphorical thinking. Prof. Aditya Kolachana provided an overview of Acyuta Piṣāraṭi's *Uparāgakriyākrama* and presented insights from this 16th-century text on eclipse computations, detailing its advancements over Nilakantha's earlier works and its use of precise astronomical parameters. In her presentation, Dr. Lalitha Sarma dwelt upon Kṛṣṇa Daivajña's interpretation of negative numbers in *Bījapallava*, contextualizing its historical evolution and application within Indian mathematical texts. The last speaker for the day, Dr. Ashish Karn, gave a sociological perspective on "Mathematical Consciousness in India: Numbers and Beyond." Dr. Karn highlighted India's deep-rooted numerical awareness, exploring its societal implications and influence on culture, naming traditions, and the philosophical ethos surrounding mathematics.

4 Day 3: January 21, 2025

4.1 Tribute to Prof. R.C. Gupta

A special tribute session was moderated by Prof. K. Ramasubramanian, featuring three talks by Profs. S.G. Dani, M.S. Sriram and Prof. Ramasubramanian. The three talks were interspersed with three short video clips curated by the HoMI project team of IIT Gandhinagar.

Prof. Dani provided a detailed summary of Prof. Gupta's contributions, highlighting key insights from his scholarly papers and commending his ability to maintain objectivity in his research. Prof. Sriram focused on Gupta's Hindi writings, emphasizing their role in making significant Indian mathematical contributions accessible to a general audience. Prof. Ramasubramanian, drawing from his close interactions with Prof. Gupta and his family, shed light on his virtues, including his humility, integrity, simplicity, generosity and dedication to the cause of promoting history of mathematics.

The three talks thus really complemented each other, offering a multifaceted view of Prof. Gupta's personality and impact. Prof. Michel Danino mentioned that English translations of the two books on History of Mathematics in India authored by Gupta are now being brought out under the HoMI project. The session also featured three well curated video clips that really captivated the audience, vividly showcasing his simple lifestyle, unassuming nature, and some unique aspects of his library collection. The clips were taken from video recordings made at Prof. Gupta's residence at Ras Bahar Colony in Jhansi. By the end of 2023, a team led by Prof. Ramasubramanian and Sri Raghavasimhan visited his home, with all the apparatus and the entire trip was sponsored by HoMI project.

4.2 Research Presentations

Several research presentations explored topics such as the history of mathematical journalism, Indian algebraic techniques, and combinatorial methodologies in ancient texts.

Prof. C.S. Aravinda, the chief editor of *Bhāvanā* spoke on "The Journey of *Bhāvanā* Magazine." He reflected on the magazine's role in ethnomathematics and public understanding of mathematics, offering insights into the nuances of scientific journalism in the history of mathematics. Subsequently, Dr. V. Ramakalyani spoke on "*Upapattis* in the *Gaṇitāmṛtakūpikā*, an Unpublished Commentary on *Līlāvatī*." She discussed Sūryadasa's 16th-century commentary on *Līlāvatī*, which integrates proofs (*upapattis*) and step-by-step solutions to enhance understanding of Bhaskara II's mathematical rules.

The afternoon session of 21st Jan had six Technical Presentations. The first speaker was Mandadi Varuneshwar Reddy who presented "A Quadrilayered Perspective on 4×4 Pandiagonal Magic Squares." He provided a framework for analyzing 4×4 pandiagonal magic squares, building on historical insights from Nārāyaṇa Pandita's *turagagati* method and exploring novel structural properties. Sreeram Gopinath explored Brahmagupta's *kuṭṭaka* algorithm for solving linear equations, highlighting its applications in astronomy and its elaboration in the *Vāsanābhāṣya* commentary. This was followed by "An Overview of *Ankapāśa*" in *Gaṇitakaumudi* by Aditya Dwivedi. He discussed Chapter 13 of *Gaṇitakaumudi*, focusing on its treatment of sequences and combinatorial constructs like *matsyameru*, illustrating their mathematical significance.

Dr. G. Raja Rajeswari presented key Algebraic Ideas in *Brahmasphuṭasiddhānta*, highlighting Brahmagupta's pioneering work on zero, negative numbers, and quadratic equations, and emphasizing its commentary-rich tradition that bridges brevity and clarity. This was followed by a presentation on "Revisiting *Tithinirṇaya*" by Nagakiran Yelluru. He critically analyzed the text, proposing a new interpretation of its astronomical methods and resolving authorship controversies. The final presentation for the day was by Jay Kant Mandal on *naṣṭa* and *uddiṣṭa* of *druta-meru* in *Saṅgītaratnākara*. He examined the text using combinatorial tools, including *druta-meru*, showcasing the depth of Śārṅgadeva's mathematical ingenuity and its cultural legacy.

5 Day 4: January 22, 2025

The concluding day featured in-depth discussions on topics such as the *Kuṭṭaka Method* for solving linear Diophantine equations, the role of mathematics in Indian Knowledge Systems, Aryabhata's algorithmic approaches, and the integration of poetic elements into mathematical discourse.

The first speaker was Prof Srinivas Reddy spoke on "The *Kuṭṭaka* Method: Limits and Potentials for Solving Linear Diophantine Equations." Prof. Reddy delved into the *kuṭṭaka* method, an ancient Indian algorithm for solving linear Diophantine equations, as outlined in Bhaskara II's *Līlāvatī*. He compared its efficiency with the extended Euclidean algorithm, highlighting its strengths, limitations, and potential

refinements for broader applicability. Prof. Ravi Kulkarni spoke next on the "Role of Mathematics in the Promotion of IKS." Prof. Kulkarni discussed how Indian Knowledge Systems (IKS) integrate mathematical frameworks across disciplines. He proposed a conceptual mapping where Indian philosophical schools like *Nyāya* and *Vedānta* align with modern scientific thought, demonstrating mathematics as a unifying tool in explaining diverse human experiences.

Prof. S. A. Katre made a fairly technical presentation on "The nth Roots of a Power Series Using Aryabhata's Method." He expanded on Aryabhata's algorithms for square and cube roots, illustrating how they can be generalized to compute nth roots of power series. His insights connected historical techniques to modern computational applications. The next speaker was Dr. Nagendra Pavana who spoke on the "Poetic Excellence of Varāhamihira in Expressing Scientific Concepts." Dr. Pavana explored how Varāhamihira's *Bṛhatsaṃhitā* blends mathematics, astronomy, and poetic elegance. He highlighted the use of metaphors, similes, and intricate poetic meters, demonstrating how scientific knowledge was both encoded and enhanced through poetic expression.

The final presentation was by Chandrahas Halai on the "Simplex Numbers in the *Meru Prastāra*." Mr. Halai presented a structured analysis of simplex numbers, explaining their hierarchical formation in *meru prastāra* (Pascal's Triangle) and their connection to figurate numbers. He demonstrated how these patterns extend mathematical understanding across multiple dimensions.

The valedictory session, led by Prof. Michel Danino and Prof. K. Ramasubramanian, provided closing remarks, expressing appreciation for the speakers, participants, and organizers. The event was acknowledged for its success in fostering an engaging dialogue on India's mathematical heritage.

6 Conclusion

Ganita Sammelan 2025 successfully showcased India's rich mathematical traditions and their relevance to modern scholarship. Across multiple days of thought-provoking talks, technical presentations, and interactive sessions, the conference reinforced the enduring impact of Indian mathematical contributions. The event concluded on an inspiring note, encouraging further research and exploration into India's rich mathematical heritage.