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Legacy that inspires the future

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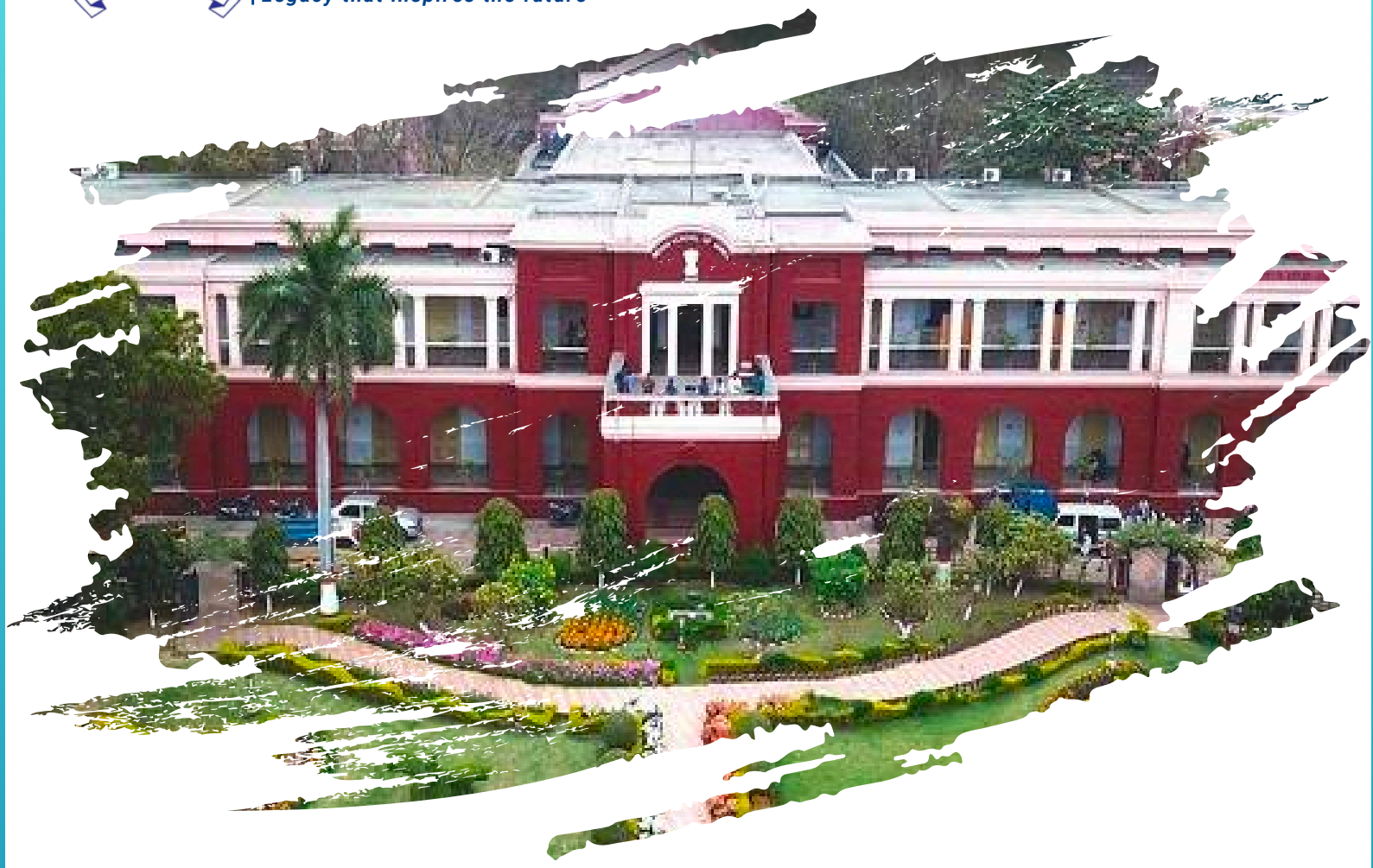
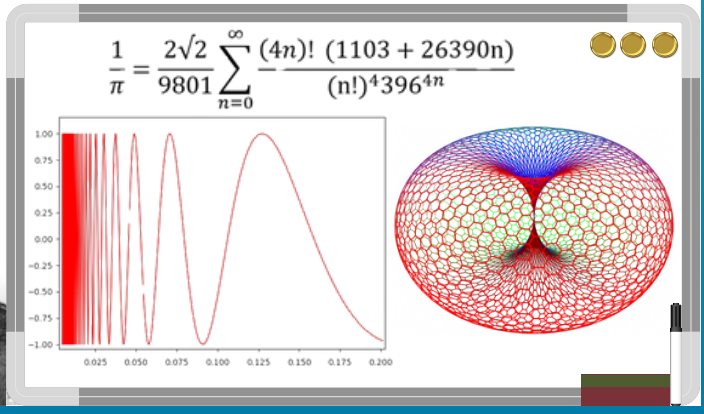


GANANAM

A Monthly Newsletter of

Department of Mathematics and Computing



KNOWN INDIAN MATHEMATICIAN BORN IN JANUARY

D. R. Kaprekar, born on 17 January 1905, in Dahanu, Maharashtra, India, was a self-taught mathematician renowned for his contributions to number theory. He attended Vidyamandir High School and later the University of Mumbai, where he earned his bachelor's degree in 1929. Despite his formal education, Kaprekar's true passion for mathematics led him to explore complex number theory concepts independently, making groundbreaking discoveries in the field. In 1927, Kaprekar's talent was recognized when he won the prestigious Wrangler R. P. Paranjpye Mathematical Prize for an original piece of work in mathematics. This marked an early highlight in his career, although his contributions went largely unnoticed by the broader mathematical community during his lifetime.

Kaprekar is best known for discovering Kaprekar numbers and the Kaprekar constant (6174). A Kaprekar number is a number that, when squared and split into two parts, results in the sum of those parts equaling the original number. For example, 9 is a Kaprekar number because $9^2 = 81$, and $8 + 1 = 9$. The Kaprekar constant, 6174, is another of his famous discoveries. If you take any four-digit number (with at least two different digits), arrange its digits in ascending and descending order, and subtract the smaller from the larger, repeating the process will always bring you to the number 6174, no matter the starting number.

Kaprekar spent much of his life working as a school teacher and remained largely in obscurity, publishing his work in lesser-known journals. Despite this, his discoveries, particularly regarding the Kaprekar constant and Kaprekar numbers, gained appreciation over time, especially within the realm of recreational mathematics. Although he did not receive widespread formal recognition or major awards during his lifetime, Kaprekar's contributions have since been acknowledged by the mathematical community, and his work continues to inspire both mathematicians and math enthusiasts. Today, his legacy remains celebrated, and his discoveries are an integral part of number theory studies. Kaprekar's story is a testament to the power of curiosity, persistence, and the beauty of numbers.

PUBLICATIONS

- R. Ghosh, and **A. A. Selvan**, On Gabor frames generated by B-splines, totally positive functions, and Hermite functions, Applied Numerical Mathematics, 207, 1-23, 2025.
- **A. Jayswal,** P. S., and J. C. Yao, LP well-posedness for multidimensional bilevel controlled variational inequalities, Optimization, 1-25, 2025.
- B.K. Lenka, and **R. K. Upadhyay**, New Lyapunov attractive theorems for real-order systems with applications, J. Innovation Sciences and Sustainable Technologies, 5(1), 1-37, 2025.
- B.K. Lenka, and **R. K. Upadhyay**, A new way to synchronize memory chaos, Differential Equations and Dynamical Systems, 2025, (Accepted).
- S. Yadav, J. P. Tripathi, S. Bhuri, S. K. Tiwari, D. Tripathi, Vandana Tiwari, **R. K. Upadhyay**, and Y. Kang, Ecological system with fear induced group defense and prey refuge, Differential Equations and Dynamical Systems, 2025, (Accepted).
- M. Biswas and **S. A. Sahu**, On the Rayleigh wave velocity in n-type piezoelectric semiconductors with enhanced flexoelectricity, Mathematics and Mechanics of Solids (SAGE), 2025, (Accepted).

INVITED TALKS / VISITS

- **Prof. P. S. Rao** delivered an invited talk on “Mathematics for AI/ML Applications in Atmospheric and Space Sciences” at the National Atmospheric Research Laboratory, Department of Space, Govt. of India, Gadanki (Tirupathi) on 21 January 2025.
- **Prof. A. Jayswal** delivered an invited talk on “Exact penalty results for semi-infinite interval-valued mathematical programs with vanishing constraints” at the Indian Statistical Institute, Delhi, on 22 January 2025.
- **Prof. S. P. Tiwari** delivered an invited talk on “Automata theory: A mathematical perspective” at the National Institute of Technology Calicut on 31 January 2025.
- **Prof. M. K. Singh** visited LRDE, DRDO lab Bangalore on 27 January 2025 for a discussion on SAR data analysis with Dr. Dhiraj Kumar Singh, Scientist "F' and Project Director.

EVENTS ORGANISED

Yuva Sangam Phase V

As a part of Yuva Sangam phase V, the Nodal officer of Jharkhand, Prof. S. A. Sahu, and his team visited the Governor's house (Rajbhawan) Ranchi with Uttarakhand contingents on 17.01.2025. Prof. S. A. Sahu and Prof. Scindhiya Laxmi of the Department of Mathematics and Computing represented the nodal HEI of Jharkhand IIT(ISM) Dhanbad. They apprised the Hon. Governor of Jharkhand, Shri Santosh Gangwar ji, about the program Yuva Sangam being conducted by the Ministry of Education under the Ek Bharat Shrestha Bharat scheme. Prof. S. A. Sahu presented a token of remembrance on behalf of Nodal HEI IIT (ISM) DHANBAD. Hon. Governor extended his best wishes for the grand success of the Yuva Sangam program.

Departmental Expert Talk Series

As part of the Expert Talk Series initiated by the department, a renowned quantum information theorist, Prof. Mark M. Wilde (IEEE fellow) from Cornell University, delivered a talk titled Machina Ex Quanta: Rise of the Quantum Boltzmann Machines on January 10, 2025. Prof. Wilde describes his recent contributions to the quantum version of Boltzmann machines, which can be understood as parameterized thermal states of local Hamiltonians. While this generalization makes non-commuting Hamiltonians inaccessible in the classical case, training them for various optimization tasks has remained an obstacle. In the talk, Prof. Wilde discussed overcoming this obstacle by deriving analytical expressions for the gradient and providing quantum algorithms that can estimate it. He also talked about a new model they introduced, called evolved quantum Boltzmann machines, which uses parameterized time-evolved thermal states as an ansatz, extending the conventional model of quantum Boltzmann machines.

PHD AWARDED

Dr. Deepjyoti Saha has been awarded a Ph.D. in Software Dependability Analysis under the esteemed guidance of **Prof. S. Chatterjee**. He joined as a JRF in an ISRO-funded research project. His research is dedicated to enhancing the reliability, security, and robustness of software systems that ensure high dependability in critical applications. His work delves into analyzing, modelling, and predicting dependability attributes, focusing on identifying dependable and non-dependable software modules while ranking them in the early phases of software development. By harnessing the power of machine learning, soft computing, and deep learning techniques, he has developed advanced models that significantly improve software reliability across diverse domains, such as safety-critical applications.
Additionally, he has proposed various statistical models based on real assumptions for predicting software reliability and estimating the remaining faults during the testing phase, contributing to more efficient and precise software quality assessments. His research advances the field of dependable computing and strikes an optimal balance between efficiency, security, and fault tolerance that paves the way for developing more robust and trustworthy software systems. He was a part of the software development team and developed software for reliability analysis under the ISRO-funded project. The software was delivered to SAC, Ahmedabad.

Dr. Mahargha Biswas, under the supervision of **Prof. S. A. Sahu,** defended his Ph.D. thesis entitled "Study of Wave Transference and Scattering Phenomenon in Piezo-composite Structures with Distinct Interfacial Conditions" on January 22, 2025. His thesis investigates the characteristics of mechanical waves propagating through piezoelectric and piezomagnetic media under various conditions. The research primarily focuses on the theoretical mathematical modelling of physical phenomena with potentially real-world applications of mechanical waves. In addition to the piezoelectric effect, the study incorporates the more intricate flexoelectric and flexomagnetic effects in both piezoelectric and piezomagnetic media. Key aspects explored in this work include the velocity, amplitude, and attenuation of surface and body waves.

Dr. Narayan Choudhary received his PhD in the field of categorical and algebraic studies of automata based on different lattice structures, under the guidance of **Prof. S. P. Tiwari**. His research aimed to establish a monoidal framework for automata composition and to explore the associated categorical and algebraic concepts. The work specifically investigates four categories of automata based on residuated lattices, demonstrating that each category has a symmetric monoidal structure, including a product, coproduct, internal monoid, and co-monoid. Additionally, his study delves into the products of L-fuzzy automata, examining their connection to fuzzy languages and their covering characteristics. The research also contributes to the decentralized supervisory control theory of fuzzy partitioned discrete event systems (DES) by introducing the concept of fuzzy partitioned automata.

ALUMNI SPARK

Saumya Pandey's career is a testament to adaptability and a strong drive to make a tangible impact. After graduating with an Integrated MTech in Mathematics and Computing in 2017, she began her professional journey in data analytics at Wipro. She later moved to Religare Health Insurance, where she took on a leadership role, managing a team focused on data management and analysis. These early experiences provided her with a solid foundation in data interpretation, leadership, and sector-specific knowledge, all of which would prove invaluable in her future endeavors.

A turning point in Saumya's career came when she joined NITI Aayog, the Government of India's premier policy think tank. As part of the Energy and International Cooperation team, she embraced a multifaceted role that included data management, analysis, team leadership, and product management. Her work with academia, industry, and international organizations like the World Bank and GIZ gave her a deep understanding of the policymaking process and allowed her to contribute to India's energy landscape. Working directly with Mr. Amitabh Kant (then CEO of NITI Aayog, now G20 Sherpa for India), she saw how data-driven insights could shape policy decisions and drive impactful change.

Currently, Saumya is a Senior Consultant in the energy sector at KPMG India, where she advises clients on the challenges and opportunities within the evolving energy sector. From her early days analyzing data at Wipro to influencing policy at NITI Aayog and now consulting at KPMG, her journey demonstrates the power of diverse experiences and the potential for growth and impact when one remains committed to continuous learning. Her story is an inspiring example for aspiring professionals, emphasizing the importance of adaptability and a dedication to making a difference. Saumya attributes much of her growth to her time at IIT (ISM) Dhanbad, where the Mathematics and Computing department fostered an environment of all-around development. This structure not only shaped her as an engineer but also as a responsible and contributing member of society.

MATHEMATICS AND COMPUTING NEWS

- DeepSeek, a Hangzhou-based company, released DeepSeek-R1, a reasoning model rivalling OpenAI's o1, claiming superior problem-solving capabilities while consuming less computational resources. It also launched Janus-Pro-7B, an image-generation model. China's AI progress aligns with government ambitions, backed by vast investments and AI education. Other firms like Alibaba, Moonshot AI, and ByteDance unveiled advanced models, reinforcing China's AI leadership aspirations. [Read More]

- Researchers applied the mathematical theory of synchronization to clarify how recurrent neural networks (RNNs) generate predictions, revealing a certain map based on the generalized synchronization that yields correct target values. They showed that conventional reservoir computing (RC), a type of RNN, can be viewed as a linear approximation, and introduced a 'generalized readout' incorporating further order approximations. Using a chaotic time-series forecasting task, they demonstrated that this approach dramatically enhances both prediction accuracy and robustness. [Read More]

ADDITIONAL RESPONSIBILITY

- **Prof. R. K. Upadhyay** has been appointed as Associate Editor for the Babylonian Journal of Mathematics (Mesopotamia Academic Press).

- **Prof. R. K. Upadhyay** has been nominated as subject editor for the National Academy Science Letters (Springer).

- **Prof. T. Ojha** has been appointed as an Editorial Board Member of Scientific Report (Springer Nature).

- **Prof. H. K. Mishra** has been appointed Associate Editor in the Indian journal JISST.

- **Prof. S. Chatterjee** has been appointed as IEEE Senior Member.

STUDENT ACTIVITIES

1. **Pallabi Samal** presented a paper "On LP well-posedness of multidimensional bilevel controlled variational inequalities" at International Conference on Computational Operations Research and Algorithmic Game Theory, ISI, Delhi, 21-22 January 2025.

2. **Ajeet Kumar** presented a paper, "A Parametric approach for robust semi-infinite interval-valued optimization problems" at International Conference on Computational Operations Research and Algorithmic Game Theory, ISI, Delhi, 21-22 January 2025.

3. **Gaurav Uniyal** presented a paper, "Semi-infinite variational programming problem with Caputo- Fabrizio fractional derivative" at International Conference on Computational Operations Research and Algorithmic Game Theory, ISI, Delhi, 21-22 January 2025.

SPONSORED PROJECTS

Prof. M. K. Singh has been awarded a grant of INR 3.35 Lakhs by ANRF, New Delhi (Ref. No. TAR/2022/000472) for the project titled "Investigating the impact of pore geometry on the non-linear filtration characteristics in porous media".

EDITORIAL TEAM

Prof. S P Tiwari (HOD), Prof. P S Rao, Prof. Atul Kumar Verma, Prof. Tamoghna Ojha, Naman Shankar Srivastava, Hima Chowdary Tanikonda.
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