

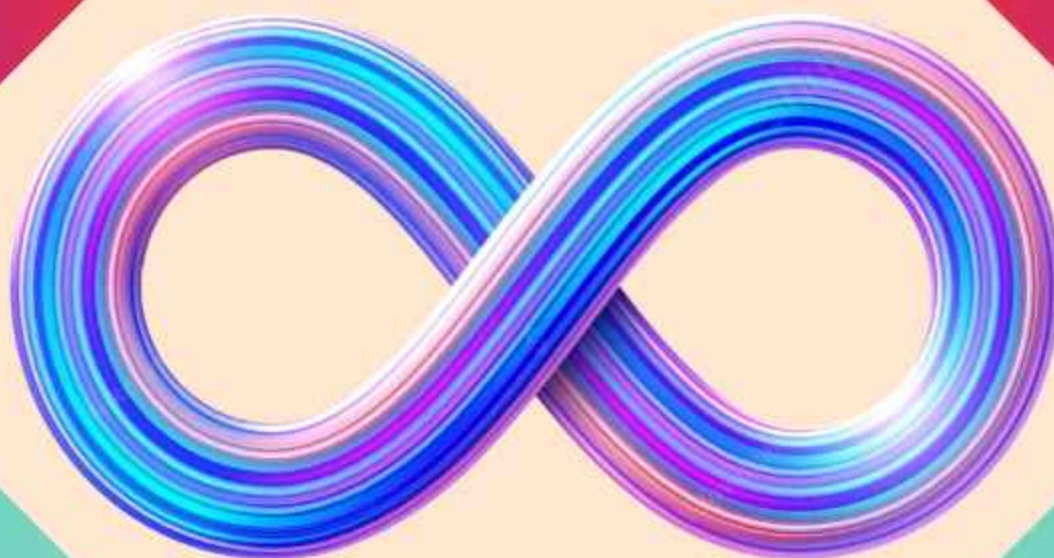


MANIPAL UNIVERSITY
JAIPUR

January-June 2026
Issue 3.1

INFINITY INSIGHT

Biannual Newsletter



Department of Mathematics and Statistics
School of Physical and Biological Sciences
Faculty of Science, Technology and Architecture

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Editorial Note...



**"THE ONLY WAY TO DISCOVER THE LIMITS OF THE POSSIBLE
IS TO GO BEYOND THEM INTO THE IMPOSSIBLE"**

- ARTHUR C. CLARKE

Dear Readers,

Welcome to the latest **Biannual Edition** of our newsletter *Infinity Insight*. As we begin a new academic year, we are delighted to share this edition, which recounts the achievements, milestones, and memorable moments of our department over the past six months.

Infinity Insight is more than a newsletter - it is a reflection of our vibrant academic community, showcasing excellence in teaching, research, innovation, student accomplishments, outreach activities, and collaborative initiatives. Every page celebrates the dedication and enthusiasm of our faculty, students and research scholars, whose collective efforts continue to strengthen our department.

A new academic session brings fresh aspirations, new opportunities, and the promise of greater accomplishments. As we move forward together, let this edition serve as a reminder of what we have achieved and as an inspiration for the journey that lies ahead.

We express our sincere gratitude to everyone who contributed to this edition and to our readers for their continued encouragement and support. We hope you will find Infinity Insight informative, engaging, and inspiring.

Wishing you all a successful, enriching, and fulfilling academic year ahead.

Happy Reading!

Best Regards,
Dr Reema Jain

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<i>Infinity Insight_2.4</i>	https://flipbookpdf.net/web/site/8527b50be701438542771ae6541512f0c1265cc3202601.pdf.htm

VISION & MISSION



VISION

To be a global hub for academic excellence, innovation, and human development in mathematical sciences



MISSION

- ❖ Groom students' abilities to embrace newly developing fields in statistics and mathematics.
- ❖ Emphasize the interdisciplinary collaboration for holistic problem-solving in real-world scenarios.
- ❖ Enhance good human values for ethical and responsible research.
- ❖ Develop competent professionals in mathematics and statistics.
- ❖ Contribute to societal well-being through data-driven solutions.

EVENTS ORGANIZED

VOICES AND VISION : OPEN FORUM WITH THE LEADERSHIP

A student interaction meeting was successfully conducted by the Department of Mathematics and Statistics at Manipal University Jaipur on February 10, 2026. The session was led by Head of the Department, Dr Reema Jain, who conducted a highly engaging and interactive discussion with the students. The session was attended by all Undergraduate (UG) and Postgraduate (PG) students of the department. The primary objective of the meeting was to foster open communication between the students and the department, while also providing key updates regarding academic developments. During the session, the HoD delivered an insightful address and conducted a live interactive discussion

with the students. One of the key highlights of the meeting was the detailed discussion about the new academic programme set to be launched by the department in the upcoming academic year. The HoD elaborated on the objectives, structure, and potential opportunities associated with the program, emphasizing its relevance in current academic and industry contexts. In addition to this, the session was highly student centric. Students were given the opportunity to openly share their concerns, suggestions, and challenges related to academics, infrastructure, and overall learning experience. The HoD listened attentively and assured that necessary steps would be taken to address the issues raised. The interaction created a supportive and transparent environment, strengthening the bond between students and faculty. It also reflected the department's commitment to continuous improvement and student welfare. Overall, the session proved to be highly productive and engaging, providing valuable insights to both students and the department while reinforcing a culture of open dialogue and academic excellence.



Student Coordinator : **Atreya Ghoshal**

NATIONAL SCIENCE DAY 2026



The School of Physical and Biological Sciences enthusiastically celebrated National Science Day 2026, on February 28, 2026, with the objective of fostering scientific curiosity, innovation, and a spirit of inquiry among students. The event was graced by Smt. Nidhi Bansal, Scientist 'H' and Director of TDF, DRDO, as the Chief Guest. Her inspiring address motivated the participants to pursue scientific excellence and contribute to the nation's technological advancement. A variety of engaging competitions and activities were organized throughout the day, including Quiz, Clue Quest, Poster Presentation, Rangoli, Film/Reel Making, and a Science Model Exhibition, providing students

with a platform to showcase their creativity, knowledge, and innovative ideas. One of the major attractions of the celebration was the “Fun with Science” experiment show conducted by the Gram Asha Club, which captivated the audience through interactive demonstrations and hands-on scientific experiments, making science both enjoyable and accessible. The event witnessed enthusiastic participation from students and faculty, making the celebration a grand success.



Student Coordinator : **Navya Negi & Atreya Ghoshal**

FACULTY DEVELOPMENT PROGRAM



A five-day Faculty Development Program (FDP) on “MATLAB Essentials for Science and Engineering” was organized by the Department of Mathematics and Statistics in collaboration of MUJ-TEC and NITTTR Chandigarh from March 09-13, 2026. The primary objective of the program was to enhance participants proficiency in MATLAB for scientific computing, data analysis, and engineering applications, thereby strengthening teaching and research capabilities. The FDP focused on practical exposure to numerical methods, visualization, and simulation techniques using

MATLAB. The sessions were conducted by

domain experts providing insights into real-world problem-solving and interdisciplinary applications. The program benefited faculty members, research scholars, and postgraduate students from diverse science and engineering backgrounds. A significant number of participants actively attended and engaged throughout the sessions. The key outcomes included improved computational skills, enhanced understanding of MATLAB-based modelling, and the ability to integrate these tools into their research work, fostering innovation and technical competency among participants.

Convener : **Dr Anil Ahlawat**

EXPERT LECTURE

Industry Expert Lecture on Compound Geometric Shared Frailty Models Based on Additive Hazard

(March 11, 2026)

The Department of Mathematics and Statistics organized an expert lecture on “Compound Geometric Shared Frailty Models Based on Additive Hazard” delivered by Dr David D. Hanagal, Emeritus Professor of Statistics, Savitribai Phule Pune University.

Convener : **Dr Monika Saini**

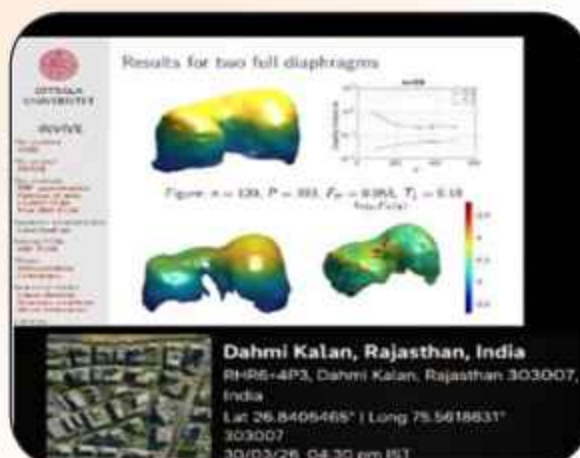


Expert Lecture on Numerical Modeling of the Human Diaphragm

(March 30, 2026)

The Department of Mathematics and Statistics organized an insightful online expert lecture on “Numerical Modeling of the Human Diaphragm” on March 30, 2026. The lecture was delivered by Prof. Elisabeth Larsson from the Department of Information Technology, Division of Scientific Computing, Uppsala University, Sweden. A key aspect of the lecture was its focus on real-world challenges, including modeling non-convex biological structures and improving accuracy through refined simulations.”

Convener : **Dr Bhagya Shree Meena**



(March 31, 2026)

Convener : **Mohammad Rizwanullah**
Dr Bijender Singh



MATHEMATICS OUTREACH PROGRAM

SCHOOL VISIT & CONCEPT LEARNING INITIATIVE

On April 7, 2026, the Department of Mathematics and Statistics at Manipal University Jaipur, in collaboration with the Directorate of Students Welfare (DSW) and the Savyasachi Care Foundation, Jaipur, successfully executed a comprehensive community outreach initiative titled the "Mathematics Outreach Program - School Visit & Concept Learning Initiative". This significant educational event took place at Suryansh International Sec School, situated on Ajmer Road Devaliya, Jaipur.



The primary intent of this endeavor was to effectively bridge the gap between theoretical knowledge and practical understanding by engaging school students in simplified and interactive mathematical concepts. Furthermore, the initiative aimed to make a substantial contribution toward goals of quality education and robust community engagement, concurrently providing invaluable, hands-on teaching exposure to the participating B.Sc. (Hons.) Mathematics

students of the department. During this event, the students and faculty members delivered a variety of short, impactful lectures that utilized innovative pedagogical tools, including compelling visual aids, and relatable real-life examples. Additionally, goodies (stationery items, chocolates, etc.) were distributed among school students to encourage participation and create a positive learning environment.

Convener : **Dr Garima Agarwal**
Dr Alka Choudhary

RESEARCH VISIBILITY

FACULTY PUBLICATIONS

Q1 Journal Publications				
S. No	Name of Faculty	Title of Publication	Journal	Month of Publication
1	Dr Reema Jain	Modelling the Distribution and Transport of Heavy Metals on Water and Soil: A Systematic Review	International Journal of Environmental Science and Technology	January 2026
2	Dr Kalpna Sharma	Research on MHD Squeeze Nanofluid Flow Between Parallel Plates with Cross-Diffusion Effects Exploiting Oham Method	Discover Applied Sciences	January 2026
3	Dr Ashish Kumar & Dr Monika Saini	Availability Prediction of Solar Water Pumping System Through Stochastic Modeling and Nature-Inspired Algorithms	Discover Artificial Intelligence	January 2026
4	Dr Parvin Kumari	An Efficient Spline Method to Solve Two-Parameter 1D Parabolic Singularly Perturbed Systems with Time Delay and Different Diffusion Parameters	Journal of Applied Mathematics and Computing	January 2026
5	Dr Ruchika Mehta	Numerical Analysis of Williamson Nanofluid Flow over a Stretched Sheet in a Porous Medium with Radiation and Heat Source/Sink Effects	Fractals	February 2026
6	Dr Ruchika Mehta	Optically Controlled Microstrip Transmission Line for Slow Wave Propagation	International Journal of Modern Physics C	February 2026
7	Dr Ruchika Mehta	Numerical Analysis of MHD Darcy–Förchheimer Williamson Hybrid Nanofluid Flow with Brownian and Thermophoretic Effects	Discover Applied Sciences	February 2026
8	Dr Garima Agarwal	Qualitative Behavior of a Fractional Order Disease Model: Optimal Control and Cost-Effectiveness Analysis	Journal of Low Frequency Noise, Vibration and Active Control	February 2026

9	Dr Parvin Kumari	A Shishkin Mesh Based Modified Bi-Cubic B-Spline Approach for Two-Dimensional Elliptic Convection-Diffusion Problems with Regular Boundary Layers	Numerical Algorithms	March 2026
10	Dr Anil Ahlawat & Dr Shilpa Chaudhary	Photo-Thermo-Acoustic Interactions in a Fiber-Reinforced Nonlocal Semiconductor Medium	International Journal of Numerical Methods for Heat & Fluid Flow	March 2026
11	Dr Garima Agarwal	Qualitative Behavior of a Fractional Order Disease Model: Optimal Control and Cost-Effectiveness Analysis	Journal of Low Frequency Noise, Vibration and Active Control	March 2026
12	Dr Ruchika Mehta	Numerical Investigation of Micropolar Aluminium Oxide Nanofluid Flow over an Inclined Stretching Sheet	Discover Applied Sciences	March 2026
13	Dr Ashok Kumar Pal	Analysis of Halo and Lissajous Orbits Under the Perturbation of Continued Fraction Effect	Chaos, Solitons & Fractals	March 2026
14	Dr Alok Bhargava	On the Simulation of Fractional Riccati Equations with Physics-Informed Neural Networks	Discover Applied Sciences	March 2026
15	Dr Garima Agarwal & Dr Parvin Kumari	Analysis of Human and Rodent Population in Leptospirosis Disease Using Numerical Methods	Discover Applied Sciences	March 2026
16	Dr Garima Agarwal	Fractional-Order Epidemic Modeling with a Deepneural Network Framework	Scientific Reports	March 2026
17	Dr Reema Jain	Numerical and Machine Learning Investigation of Heat and Mass Transfer in Casson Hybrid Nanofluid Flow over a Riga Plate with Bio-Convection Effects	Discover Applied Sciences	April 2026
18	Dr Pooja Sharma	Investigation of Brownian Motion/Thermophoresis Impacts on Radiative Viscoelastic Chemically Reactive Magnetite Fluid Flow on a Stretching Sheet	Discover Applied Science	April 2026
19	Dr Alok Bhargava	A Mesh-Free Neural Approach to Fractional Diffusion in Li-ion Battery Materials	Discover Applied Sciences	April 2026

20	Dr Shilpa Chaudhary & Dr Anil Ahlawat	Hyperbolic Two-Temperature Behavior in a Nonlocal Fiber-Reinforced Semiconducting Medium Under Moore-Gibson-Thompson Model	Mathematics and Mechanics of Solids	April 2026
21	Dr Shamshad Ur Rasool	Design-Aware Surrogate Modeling for Nonlinear Energy Consumption Analysis Using Gaussian Process Regression	Discover Applied Sciences	May 2026
22	Dr Giriraj Methi	Mathematical Modeling of Emission-Driven Aerosols and Acid Rain Formation and Their Impact on Plant Biomass	Aerosol and Air Quality Research	May 2026
23	Dr Reema Jain	Thermal Optimization and Heat Transfer Enhancement in Bioconvective Maxwell Penta-Hybrid Nanofluid Flow Past an Extending Surface Using Fuzzy Logic and Hybrid ANN-PSO Approaches	Results in Engineering	June 2026
24	Dr Reema Jain	Impact of Cattaneo-Christov Heat and Mass Flux on 3D Flow of Maxwell Nanofluid Past a Heated Porous Surface with Microorganisms	International Journal of Thermofluids	June 2026
25	Dr Ashok Kumar Pal	Analysis of the Modified Perturbed CR3BP to a Five-Body System	Advances in Space Research	June 2026
26	Dr Alok Bhargava	A Novel Approach to Fractional Kinetic Equations Involving Srivastava Polynomial and Multi-Index Bessel Function	Computational Methods for Differential Equations	June 2026
27	Dr Alok Bhargava	A Hybrid GDQM-ANN Framework for Entropy Generation Prediction in Radiative MHD Flow Through an Inclined Porous Channel	Discover Applied Sciences	June 2026
28	Dr Parvin Kumari	An Efficient Parameter-Uniform Method for Solving Two-Parameter Singularly Perturbed Parabolic Problems	Journal Of Computational and Applied Mathematics	June 2026
29	Dr Parvin Kumari	A Parameter-Uniform Modified Bi-Cubic B-Spline Approach for 2D Singularly Perturbed Elliptic Weakly Coupled Systems	Computers & Mathematics with Applications	June 2026
30	Dr Anil Ahlawat & Dr Shilpa Chaudhary	Numerical Analysis of Thermomagnetic-Convection and Irreversibility Control of Micropolar Hybrid Nanofluid Flow within a Wavy-Trapezoidal Enclosure	Applied Thermal Engineering	June 2026

Other Journal Publications

S. No.	Name of Faculty	Title of Publication	Journal	Month of Publication
1	Dr Alok Bhargava	A Neural Network Approach for Composite Fractional Relaxation Oscillation Equations in Complex Dynamical Systems	AIP Advances	January 2026
2	Dr Shilpa Chaudhary	Analysis of Magneto Thermoelastic Plane Waves in Biological Tissue with Voids and Variable Thermal Conductivity Under Dual Phase Lag Model	Heat Transfer	February 2026
3	Dr Ashish Kumar & Dr Monika Saini	Enhanced Exponential Type Ratio Estimator for Estimating Population Mean in Stratified Random Sampling under Linear Cost Function	Lobachevskii Journal of Mathematics	February 2026
4	Dr Mohammad Rizwanullah	New Ranking Approach for Solving Hexagonal Type Fuzzy Assignment Problems Using Branch and Bound Technique	IAENG International Journal of Applied Mathematics	February 2026
5	Dr Monika Saini & Dr Ashish Kumar	Transient Analysis of a Smart Stochastic Model for Tube-wells Integrated with Underground Pipelines for Sustainable Agriculture	Brazilian Journal of Biometrics	March 2026
6	Dr Garima Agarwal	Analysis of Infectious Fractional Disease Model	Palestine Journal of Mathematics	March 2026
7	Dr Ruchika Mehta	Numerical Investigation of Radiative Hybrid Nanofluid Flow Containing Sodium Alginate and Aluminium Alloys over a Power-Law Stretching/ Shrinking Sheet with Suction	Journal of Thermal Engineering	March 2026
8	Dr Reema Jain	Jeffrey Hybrid Nanofluid Flow and Microbial Effects on Heat and Mass Transfer over Stretching Surfaces	Journal of Thermal Engineering	April 2026
9	Dr Alok Bhargava	Analytical Study of Caputo-Fabrizio Fractional Order Delayed Neural Network Using Fixed Point Theory	Results in Applied Mathematics	May 2026
10	Dr Anil Ahlawat	Numerical Investigation on Thermal Performance of Magnetohydrodynamic Lid Driven Nanofluid Flow in a Finned Porous Hexagonal Enclosure	Discover Mechanical Engineering	June 2026

Book Chapter/Conference Publications

S. No.	Name of Faculty	Title of Publication	Publisher	Month of Publication
1	Dr Virendra Singh Chouhan	Results on Coupled Coincidence Point with Y-Cone Metric Spaces	Analysis, Algebra, and Associated Topics (Book). Birkhäuser, Cham	January 2026
2	Dr Ashish Kumar & Dr Monika Saini	Enhancing Pulping System Performance: A Markov-Based Reliability and Availability Analysis in Paper Manufacturing Plants	Experimental and Computational Advances in Materials (Book), Springer Singapore	January 2026
3	Dr Ashish Kumar & Dr Monika Saini	Reliability and Signature Evaluation of Juice Clarification Systems of Sugar Industry	ICT for Intelligent Systems (Book), Springer Singapore	January 2026
4	Dr Vijaypal Poonia	Optimizing Location, Allocation, Inventory, and Transportation in a Circular Economy Network Using a Multi-Objective Mathematical Model	Multi-Attribute Decision-Making (Book), CRC Press	January 2026

ACTIVITY UNDER MoU

Upcoming International Conference : ACIFFS-2026

S. No.	Name of Faculty	Event	Date
1	Dr Reema Jain & Dr Verdiana Grace Masanja (NM-AIST)	International Conference on Advances in Computational Intelligence for Fluid and Fuzzy Systems (ACIFFS-2026)	July 29-31, 2026

AWARDS & ACHIEVEMENTS

ACADEMIC VISIT

S. No.	Name of Faculty	Institute/University	Purpose	Date
1	Dr Reema Jain	Indian Institute of Science, Bengaluru	Research Collaboration	June 01, 2026

GRANTS RECEIVED

S. No.	Event	Funding Agency	Amount Sanctioned
1	International Conference on Advances in Computational Intelligence for Fluid and Fuzzy Systems (ACIFFS-2026), July 29-31, 2026	Anusandhan National Research Foundation (ANRF)	INR 3,00,000
2	International Conference on Statistical Modeling, Optimization, and Data Science (SMODS 2026), October 08-10, 2026	Anusandhan National Research Foundation (ANRF)	INR 3,00,000

INNOVATION/IPR

Title	Status	Inventor	Agency	Date
An Infinity Century Calendar System (Application no. 202611032509 A)	Published	Vikas Choudhary & Dr Kalpna Sharma	Govt of India	May 08, 2026

TALKS DELIVERED

S. No.	Name of Faculty	Event	Title of Talk	Date
1	Dr Ruchika Mehta	Five-Days National Level Virtual Faculty Development Program @ Vels Institute of Science, Technology and Advanced Studies, Chennai	Thermal Performance Analysis of Micropolar Fluid Flow in a Porous Medium Using Numerical Methods	February 20, 2026
2	Dr Kalpna Sharma	International (7 th National) Conference on Recent Advancements in Physical Sciences @ National Institute of Technology Uttarakhand	Integrating Machine Learning to Explore Soret and Dufour Effects in MHD Flow of Casson Nanofluid over a Vertical Cone	February 6-8, 2026

3	Dr Ashish Kumar	Three Days Training Programme on "Statistical Theory & Data Analysis Using Softwares" @ M.D. University, Rohtak	Inferential Statistics	March 12-14, 2026
4	Dr Mohammad Rizwanullah	Workshop on Research Methodology @ M.D. University, Rohtak	Research Methodology	March 09-13, 2026
5	Dr Ashish Kumar	One -Week Training Programme for Research Scholar@ M.D. University, Rohtak	Hypothesis Testing with SPSS	March 09-13, 2026
6	Dr Ashish Kumar	One Week Interdisciplinary Short-Term Programme (Residential Mode) on "Statistical Modeling through Simulation in R" @ UGC-MMTTC, IIT (ISM) Dhanbad	Pattern Discovery using R: Cluster Analysis and Practical Applications	February 23-28, 2026
			Exploratory Factor Analysis: Theory, Assumptions, and Implementation using Statistical Software	
7	Dr Garima Agrawal	National Conference on Applications of Basic Sciences and Communication in Engineering@ JECRC Jaipur	Application of Mathematical Modelling	May 28-29, 2026

Ph.D AWARDED

S. No.	Name of Research Scholar	Name of Supervisor	Title of Thesis	Date of Award
1	Jai Chandra Yadav	Dr Mohammad Rizwanullah	Combinatorial Optimization of Tours in Networks under Fuzzy Environment	January 01, 2026
2	Sumaira Rasool	Dr Monika Saini	Evaluation and Optimization of Reliability Measures of Pulp and Paper Industry	February 13, 2026
3	Guman Singh	Dr Mohammad Rizwanullah	Optimization of Supply chain networks with Applications	March 10, 2026
4	Lata Kumari Bairwa	Dr Ashok Kumar Pal	Study of the Lagrangian Points and Periodic Orbits with Continuation Fractional Potential	May 07, 2026

EXTRACURRICULAR INVOLVEMENT

S. No.	Name of Faculty	Performance	Event	Date
1	Dr Ankur Kumar Jain	Solo Singing	State level singing competition organized by Sangam Kala Group Jaipur	February 02, 2026
		Group Singing	Expression 7.0	January 19-20, 2026
		Group Singing	Republic Day	January 26, 2026
		Solo Singing	Mahashivratri Celebration	February 15, 2026
		Solo Singing	Echoes of Rama	March 26, 2026
		Solo Singing	Spic Macay, Onerios 2026	March 13-15, 2026

STUDENTS' ACHIEVEMENTS

S. No.	Name of Student	Program	Achievement
1	Bhupendra Jangid	Ph.D.	International Travel Support by Anusandhan National Research Foundation (ANRF) to visit Masaryk University Brno, Czech Republic during June 18-22, 2026
2	Aakash Tiwari	M.Sc. II Sem	Pursuing Summer Internship at IIT Jammu Internship Topic: Data Science & AI
3	Kumkum Patel	M.Sc. II Sem	Pursuing Summer Internship at IIT Goa Internship Topic: Multivariable Analysis
4	Raksha	M.Sc. II Sem	Pursuing Summer Internship at IIT Jammu Internship Topic: Data Science & AI
5	Atreya Ghoshal	VI Sem. B.Sc. (Hons.) Mathematics	Attended an Online Training Programme on Statistics for Machine Learning, Data Science, and Artificial Intelligence, organized under the aegis of MTTs Trust, held from October 11, 2025 to February 8, 2026.

COMMUNITY ENGAGEMENT

CLUB ACTIVITIES

SOCIOTHON 2.0 - 2026

The Gram Asha Club, in collaboration with the Department of Chemistry, Manipal University Jaipur, organized Sociothon 2.0 - 2026, a social development hackathon, from January 30 to February 1, 2026. The event aimed to encourage students to develop innovative solutions to real-world social challenges using technology and creative thinking.

Focusing on areas such as healthcare, agriculture, education, environment, and infrastructure, the hackathon provided a platform for students to apply their



knowledge to meaningful problems. The event included an idea submission round followed by a presentation round, where shortlisted teams presented their solutions before a panel of judges. Open to undergraduate, postgraduate, and Ph.D. students, the event promoted interdisciplinary collaboration and practical problem-solving. A prize pool of ₹15,000 was awarded to the winners, along with participation certificates for all.

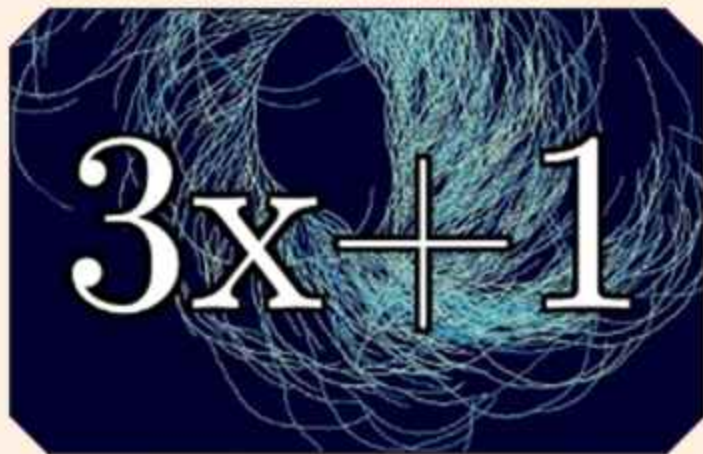
The event was supported by student volunteers, including Caleb Dsouza and Harjot Singh, second-year B.Sc. (Hons.) Mathematics students, who contributed to its smooth coordination.

Overall, Sociothon 2.0 highlighted the importance of innovation and social responsibility, encouraging students to create impactful solutions for society.

ARTICLES

THE COLLATZ CONJECTURE : WHEN A SIMPLE RULE REFUSES TO BEHAVE

Pick a number—any number. Seven, for instance. Now apply two simple rules: if the number is odd, multiply it by three and add one; if it is even, divide it by two. Repeat this process, and you will notice something curious. The numbers may rise and fall unpredictably, but they almost always settle into the same loop: 4, 2, 1. Most mathematics students, on first encountering this process, treat it as a harmless exercise—simple, almost playful. After all, the rules are easy to understand and require no advanced theory. Yet, this simplicity is precisely what makes the problem deceptive. The statement, known as the Collatz Conjecture, claims that every positive integer, regardless of its starting value, will eventually reach this repeating cycle.



At first glance, there seems little reason to doubt it. Try a few numbers, and the pattern appears consistent. However, a closer look reveals behavior that is far from predictable. Some numbers descend quickly, while others wander dramatically, rising to values far larger than where they began before eventually falling back. Even consecutive numbers can follow entirely different paths, suggesting an underlying complexity that resists simple explanation. When visualized, these sequences resemble irregular fluctuations—almost like random processes—yet they exhibit a subtle tendency to drift downward over time.

This is where intuition begins to falter. Despite extensive computational verification—testing numbers up to extraordinarily large bounds—no counterexample has ever been found. Every tested number eventually reaches one. Yet in mathematics, repeated success does not constitute proof. A single exception would be enough to invalidate the conjecture entirely. This leaves open two unsettling possibilities: either there exists some number whose sequence grows indefinitely, escaping the loop forever, or there is a hidden cycle beyond 4–2–1 that has yet to be discovered. Neither scenario has been observed, but neither has been ruled out.

Efforts to resolve the conjecture have uncovered partial insights. Statistical analyses suggest that, on average, numbers tend to decrease, lending support to the belief that all sequences eventually converge.

However, “almost always” is not sufficient in mathematics. Even recent advances, including results showing that nearly all sequences dip below their initial value, stop short of a complete proof. The final step—demonstrating that this behavior holds universally—remains elusive.

What makes the Collatz Conjecture particularly striking is not just its difficulty, but its contrast between simplicity and depth. It is a problem that can be explained in a few lines, yet has resisted decades of serious mathematical effort. It draws in both amateurs and experts alike, often with the same outcome: fascination followed by frustration. In this sense, it serves as a reminder that mathematics is not merely a collection of solved problems, but a landscape filled with mysteries that challenge even the most refined tools of reasoning.

Moral of the story: Simplicity in mathematics does not guarantee clarity; sometimes, it is precisely the simplest ideas that conceal the deepest complexities.

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1. Veritasium. (Aug 27, 2021). The Simplest Math Problem No One Can Solve – Collatz Conjecture [Video]. YouTube. <https://youtu.be/094yI Z2wpJg>
2. Collatzconjecture (n.d.). Wikipedia. Retrieved April 20, 2025, from https://en.wikipedia.org/wiki/Collatz_conjecture

By Harjot Singh

(B.Sc. (Hons.) Mathematics)

MATHEMATICS NEEDED IN AI TODAY

Artificial Intelligence (AI) often seems like a highly advanced technology, but at its core, it is built on mathematics. The foundation of this idea can be traced back to Alan Turing, who asked whether machines could think and suggested that intelligence itself could be described using mathematical rules. Today, AI systems follow this same principle—using mathematical models to learn, predict, and make decisions.

There are three main areas of mathematics that are essential in AI: **linear algebra**, **calculus**, and **probability & statistics**.

First, **linear algebra** forms the backbone of how AI represents and processes data. Computers do not understand images, text, or sounds directly. Instead, everything is converted into numbers. For example, an image becomes a matrix of pixel values, and a word becomes a vector of numbers. These vectors and matrices allow AI systems to perform operations such as transformations, comparisons, and pattern recognition. Neural networks, which are widely used in AI, rely heavily on matrix multiplication to pass information from one layer to another. In simple terms, linear algebra helps AI turn raw data into meaningful patterns.

Second, **calculus** is what allows AI models to learn from their mistakes. When an AI model makes a prediction, it compares the result with the correct answer and calculates an error using a loss function. Calculus, especially derivatives, helps determine how to reduce this error. The concept of gradients shows the direction in which the model should adjust its parameters to improve performance. A commonly used method called gradient descent updates the model step by step, gradually reducing the error over time.

Without calculus, AI systems would not be able to improve or adapt.

Third, **probability and statistics** enable AI to handle uncertainty. In real-world situations, data is often incomplete or noisy. AI systems do not give exact answers; instead, they provide probabilities. For instance, a model might predict that an email has a 90% chance of being spam. Concepts such as probability distributions, expectation, and variance help AI systems make reliable predictions. Bayes' theorem is also widely used to update predictions when new data becomes available. This ability to deal with uncertainty is crucial for applications like medical diagnosis, weather forecasting, and recommendation systems.

These three branches of mathematics work together to power modern AI. Linear algebra structures the data, calculus helps optimize the learning process, and probability provides a way to make decisions under uncertainty. Even advanced technologies like deep learning and transformer models are based on these same mathematical ideas.

In conclusion, mathematics is not just a tool used in AI—it is the foundation that makes AI possible. Every prediction, every decision, and every improvement in an AI system is driven by mathematical concepts. Understanding these principles is essential for anyone who wants to truly understand how AI works today.

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1. Veritasium. (2024). The Mathematics Behind Artificial Intelligence [Video]. YouTube.
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