ST. XAVIER'S COLLEGE, MAPUSA GOA

Report of Activity conducted in the Academic Year 2025-26

Name of Activity	National Seminar on "Recent Trends in Partial Differential Equations"
Date/ Duration	02 days, 27th and 28th February 2026, 9:00 am – 5:15 pm
Venue	Seminar Hall, St. Xavier's College, Mapusa, Goa
Name of organizing Department/Cell	Department of Mathematics
In collaboration with	Directorate of Higher Education (DHE), Government of Goa
Name/s of Faculty Co ordinator	Mr. Gajanan Parab
Stratum of Event	National
Name & details of Resource Person/s if any	Prof. A. K. Nandakumaran, Chairman and Professor, Department of Mathematics, IISc, Bangalore Prof. T. Venkatesh, Director, Mathematical Sciences Institute,Belgavi Prof. Amiya Kumar Pani, Professor, Department of Mathematics, BITS Pilani, Goa Campus Dr. Saumya Bajpai, Program Chair and Associate Professor, School of Mathematics and Computer Science, IIT Goa Dr. Y Sudhakar, Program Chair and Associate Professor, School of Mechanical Sciences, IIT Goa
Report	With the objective of seeking to promote academic interaction and exposing participants to the applications of Partial Differential Equations in modelling real-world phenomenon with exposing them to challenges and open problems requiring collaboration and interdisciplinary research, the National Seminar on "Recent Trends in Partial Differential Equations" commenced on 27th February at 9:45 a.m. in the Seminar Hall. The dignitaries were escorted to the dais by the Convenor and Coordinator of the seminar Mr. Gajanan Parab and the Head of Department, Dr. B. C. Nair. The Administrator, Fr. Antonio Salema, formally welcomed the gathering. In his address, he commended the students and faculty of the Department of Mathematics for consistently organizing programs that nurture and spread the love for mathematics. He emphasized that such academic initiatives enrich the intellectual climate of the institution and strengthen its research culture. The Principal, Ms. Ursula Barreto,

	highlighted that the Department of Mathematics is not only active in teaching but is equally vibrant in research and academic engagement. She expressed appreciation for the department's sustained efforts in organizing seminars that connect classroom learning with contemporary research. The Head of the Department, Dr. B. C. Nair, expressed his delight in bringing together researchers, academicians, and students on a common platform for meaningful discussions in Partial Differential Equations (PDEs). He emphasized that PDEs form the backbone of modelling in physics, engineering, finance, and several applied sciences. The Seminar Coordinator, Mr. Gajanan Parab, explained the rationale behind selecting the theme "Recent Trends in Partial Differential Equations." He elaborated on the importance of PDEs in modern research, their interdisciplinary relevance, and outlined the structure and flow of the seminar over two days. The Chief Guest, Prof. A. K. Nandakumaran from Indian Institute of Science, Bengaluru, in his inaugural address, delivered an inspiring message to students. He emphasized: • The importance of asking "Why?" in mathematics. • The joy of doing mathematics with curiosity. • The need to avoid distractions, especially excessive engagement with social media. • The importance for faculty members to rotate papers and teach across courses to remain intellectually engaged and updated. A significant highlight of the inaugural function was the formal launch of the Institutional Digital Repository by the Chief Guest, at the hands of the College Librarian. This marked an important step towards digital academic archiving and research dissemination. The formal Vote of Thanks was proposed by Dr. Jervin Zen Lobo. The inaugural function concluded with the college anthem followed by a group photograph and high tea. The first technical session started at 11:15 am on the topic *An Introduction to Tomography – Applications to Various Subjects including Medicine* delivered by Prof. A. K. Nandakumaran, IISc Bangalore, and moderated by Dr. Ignatius Fernandes from the Department of Mathematics of Government College of Arts, Science & Commerce, Quepem, Goa. Prof. Nandakumaran introduced tomography as a cross-sectional imaging technique grounded in mathematical modeling and inverse problems. He discussed: • Tomographic image reconstruction • Historical developments (photoacoustic effect, X-ray radon transform, NMR, ultrasound) • Modeling of X-ray tomography • Imaging of refractive index distributions The talk beautifully illustrated how PDEs and inverse problems drive modern imaging technologies such as CT scans, reinforcing the multidisciplinary nature of applied mathematics. The session ended at 12:30 pm.

	The second technical session on *Solving Non-linear Partial Differential Equations and their Implications* delivered by Prof. T. Venkatesh, Mathematical Sciences Institute, Belgavi, commenced at 12:30 pm. The session was moderated by Dr. B. C. Nair from the Department of Mathematics of St. Xavier's College, Mapusa, Goa. This session traced the evolution of quantitative finance from Louis Bachelier's early work (1900) to Kolmogorov's formal probability theory. The speaker discussed: • Diffusion processes and Brownian motion • Mathematical modeling in finance • Black–Scholes option pricing model (1973) • Interplay between stochastic processes and PDEs The lecture showcased how non-linear PDEs are deeply connected with financial mathematics and probabilistic modeling. The session concluded at 1:45 pm. There was a lunch break from 1:45 pm. The third technical session resumed at 2:15 p.m. and it was delivered by Prof. A. K. Nandakumaran on *Classical Problems from Calculus of Variation – Unified Mathematical Formulation and Beyond* and moderated by Dr. Jervin Zen Lobo from the Department of Mathematics of St. Xavier's College, Mapusa, Goa**.** This intellectually rich session covered: • Isoperimetric problems • Heron's problem • Fermat's principle in optics • Brachistochrone problem • Dirichlet principle • Euler–Lagrange equations • Pontryagin and Bellman's contributions to optimal control The lecture filled with stimulating examples, unified classical mechanics, Newton's laws, Hamiltonian systems, and PDEs under the umbrella of variational principles, inspiring students to appreciate the unity of mathematics. The session concluded at 3:30 pm. The fourth and final technical session of Day 1 started at 3:45 p.m. on the topic *PDEs and the Beauty of Fluid Dynamic.* The speaker for the same was Dr. Y. Sudhakar, IIT Goa. The session was moderated by Dr. Ignatius Fernandes. Dr. Sudhakar discussed: • Fundamentals of fluid mechanics • Continuum hypothesis • Navier–Stokes equations • Reynolds-averaged equations • Turbulence modeling • Open problems in fluid dynamics The session, through video demonstrations, emphasized practical applications while highlighting unsolved mathematical challenges

	where young researchers can contribute. The session concluded at 5:15 pm. On the second day, 28th February 2026, the first technical session started at 9:15 am. The session was on *Scientific Computing: A New Way of Looking at Mathematics* by Prof. Amiya Kumar Pani, BITS Pilani, Goa Campus. The session was moderated by Prof. Nelson Lobo from the Department of Physics of St. Xavier's College, Mapusa, Goa. Prof. Pani addressed critical questions: **"**Why re-look at mathematics?" He elaborated on how computational questions differ from classical questions. He discussed the mathematical theory on maximum/minimum principle, uniqueness and the continuous dependence property. He then proceeded to finite difference schemes and explained stability, consistence and convergence of solutions. He then discussed the toy problem and informed that the basis if simulation is scientific computing and numerical analysis. The session emphasized computational rigor and theoretical validation enforcing that mathematics is everywhere. The session concluded at 10:30 am. The second technical session of the day commenced at 10:45 am on *Advanced Numerical Techniques for Partial Differential Equations.* The speaker of the session was Dr. Saumya Bajpai, IIT Goa and the session was moderated by Dr. Jessica Pereira from School of Physical and Applied Sciences, Goa University. Motivated by the vibration of a drum, Dr. Bajpai discussed generalizing the notion of a solution. She introduced Sobolov spaces studied in the modern theory of PDEs. She informed that weak formulations no longer require classical C^2 solutions. She also mentioned that the equivalence of strong and weak forms lead to the Theory of Distributions. Dr. Bajpai then discussed the well-posedness of a particular PDE which was weakly formulated and which was analyzed using the Lax-Milgram theorem. She then discussed the Finite Element Method – how its approximation is achieved and explained the disadvantages of Finite Difference Methods. She detailed the finite element Galerkin formulation for continuous and discontinuous cases and discussed the finite element error estimates. The lecture concluded with discussion on computational software tools used in PDE modeling and the convergence study between P_1 and P_2 elements. The session concluded at 12 noon. The next session was dedicated to paper presentations. This session commenced at 12:15 pm and was moderated by Prof. Amiya Pani. A total of 04 research papers were presented by participants within and outside Goa. From outside Goa, we had research scholars and faculty from SR University, Warangal, and VIT-AP University, Amravati. From within Goa, we had faculty research scholars from Dhempe College of Arts and Science, Miramar, Goa and St. Xavier's College, Mapusa, Goa. This session concluded at 1:30 pm which was followed by a lunch break from 1:30 pm.

	The final session began at 2:15 pm and was on *Scientific Computing: A New Way of Looking at Mathematics* by Prof. Amiya Kumar Pani, moderated by Dr. Jessica Pereira. This extended session deepened discussions on theoretical foundations of computational PDEs explaining the maximum principle, discrete maximum/minimum principle, diagonal dominance and stability of systems. Prof. Pani discussed the Lax-Ritchmeyer theorem and the reliability of numerical methods. 60 participants registered from outside and within Goa actively engaged in discussions, clarifications, and interactions, making the sessions intellectually stimulating. The two-day National Seminar on *Recent Trends in Partial Differential Equations* was a grand academic success. It not only showcased the depth and diversity of PDE research but also reinforced the role of mathematics as a unifying and evolving discipline. As the final discussions concluded and participants departed with new ideas and inspiration, one thing was certain: *During these last two days, Mathematics had not merely been taught — it had been experienced* Outcomes: • Brought together eminent mathematicians from IISc, Mathematical Sciences Institute, Belgavi, IIT Goa and BITS Pilani, Goa campus. • Bridged pure theory, computational techniques, and interdisciplinary applications. • Exposed students to advanced research problems. • Encouraged faculty to broaden pedagogical perspectives. • Promoted collaborative and research-oriented thinking.
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