

Regaining India's glory



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'NISHANK'

Because the applications of mathematics are extensive and diverse, by introducing the multidisciplinary curriculum and credit-based mechanism, NEP provides flexibility to students to apply the knowledge of mathematics

Building on the storied achievements of India in the field of mathematics, NEP 2020 will help nurture a new generation of students in its goal of making the nation a 'vishwa-guru'

Numbers are one of the most innovative ideas of humankind. They make our everyday life convenient and straightforward. Imagine if numbers are not there, how difficult it would have been to measure, count, access, record and quantify different parameters. The branch of knowledge which deals with the study of numbers, i.e., mathematics is one of the most distinguished disciplines which has a 'continuum' of applications from 'zero to infinite'. At times it 'differentiates' between 'chaos' and 'stability', sometimes it 'integrates' different disciplines of knowledge. It takes us to the 'limits' of truth and encompasses the different 'dimensions' of expertise. It makes the 'complex' things 'real' and fascinates us with the notions of 'games' and 'probability'.

The discipline is inherently alluring and takes a beautiful mind to master it. Srinivasa Ramanujan is one such genius that India has produced. Yesterday, we celebrated the birthday of Srinivasan Ramanujam as the National Mathematics Day; I bow my head to this genius. On observing his genius and reading about his notebooks and life, it appears that Ramanujam came to this world to serve the discipline of mathematics only. He solved many complex problems independently and made pioneering contributions to number theory.

Bharatvarsh has a rich tradition and contributions to mathematics since ancient times. As illustrated here,

यथा शिक्षा मयूराणां,
नागानां मणयो यथा।
तद् वद् वेदाङ्गशास्त्राणां
गणितं मूर्धनि स्थितम्।।

Meaning, like the crest of a peacock, like a gem on the head of a snake, so is mathematics at the head of all knowledge. This verse from Vedanga Jyotisha (500 BC) is the testimony of the fact that at which pedestal we keep mathematics. Mathematics or 'Ganit' is a dominant discipline in India since ancient times, and the legacy is flowing over generations by 'Guru-Shishya parampara', books and works.



Iconic figures such as Srinivasa Ramanujan attest to India's long history as an innovator in math

'Sulba Sutras' written in 800-500 BCE contain concepts of geometrical shapes like square, rectangle and right triangle and square roots, etc. The Pythagoras triples are also highlights of 'Sulba Sutras'. Acharya Pingala (300 BCE) illustrated the idea of 'sunnyata' or zero for the first time. There is also evidence of zero as a placeholder in the Bakhshali manuscript. In the fifth century AD, Aryabhata gave the basis of the decimal system and calculated the value of Pi till four decimal places, to name his few contributions. Brahmagupta in the seventh century AD (7 AD) clearly defined and used zero and mentioned negative numbers.

His treatises 'Brahmasphutasiddhanta' and the 'Khandakhadyaka' have detailed illustrations about series, geometry, arithmetic and algebra, to name a few. Sridharacharya in the ninth century (9 AD) was the pioneer in finding the roots of a quadratic equation. Siddhanta Shiromani has written in four volumes, namely 'Lilavati', 'Bijaganita', 'Grahaganita' and 'Goladhyaya' by legendary Bhaskaracharya. These four volumes have complex mathematical ideas in the form of verses. Lilavati was reportedly his daughter, and the text is written addressing her. The works of Bhaskaracharya have theorems and concepts of mod-

ern-day calculus, arithmetic, trigonometry, algebra and astronomy.

In modern times also mathematicians from India have solved problems of crucial importance. Ramanujan is the epitome of mathematical excellence, apart from him, mathematicians like CR Rao, CS Seshadri, to name a few have done immense service to the discipline. Our IITs have also solved some critical mathematical problems by coming with AKS (Aggarwal-Kayal-Saxena) primality test and Karmarkar's algorithm to illustrate some instances. Manjul Bhargava who won the Fields Medal, which is equivalent to

Nobel, brought laurels to India through his number theory.

Our contributions to the discipline are of great significance since the genesis of the field. The new National Education Policy 2020 (NEP) has significant provision and provides a platform to build, nurture, foster, encourage and multiply mathematical thinking. It has introduced the reforms needed to balance the need for 21st-century employment and entrepreneurship, which is marked by critical, lateral and mathematical thinking. The NEP appreciated the necessity of mathematical thinking and its importance for the country to become a 'vishwa-guru'. The areas like big data analytics, artificial intelligence, machine learning, blockchains are the key technologies of the modern-day, and mathematics is the core of all of these technologies. Hence, it is critical to building the computation thinking and capabilities of our youngsters since the foundational stage. The NEP provides the necessary nourishment by making mathematics enjoyable and engaging using innovative methods from the foundational step itself. It is also mandated in NEP to introduce a coding curriculum from middle school as it helps in developing the computation capabilities and intuitive reasoning.

Because the applications of mathematics are extensive and diverse, by introducing the multidisciplinary curriculum and credit-based mechanism, NEP provides flexibility to students to apply the knowledge of mathematics. These reforms will be of particular importance to the student inclined towards mathematics. Also, policy provisions for establishing mathematics clubs in the HEI for better collaboration and interdisciplinary research.

I am sure that the Indian mathematical and educational system is bound to 'ramp up' under the shade of NEP. All the ideas in the policy are a keystone for a self-reliant India, a vibrant 'vishwa-guru'!

The writer is the Union Education Minister, Government of India. Views expressed are personal