



Ministry of Culture  
Government of India

75  
Azadi Ka  
Amrit Mahotsav

INDIA'S  
CONTRIBUTION TO  
**MATHEMATICS**  
THROUGH AGES  
UNDER THE AEGIS OF  
**AZADI KA AMRIT MAHOTSAV**  
COMMEMORATING 75 YEARS  
OF INDEPENDENCE

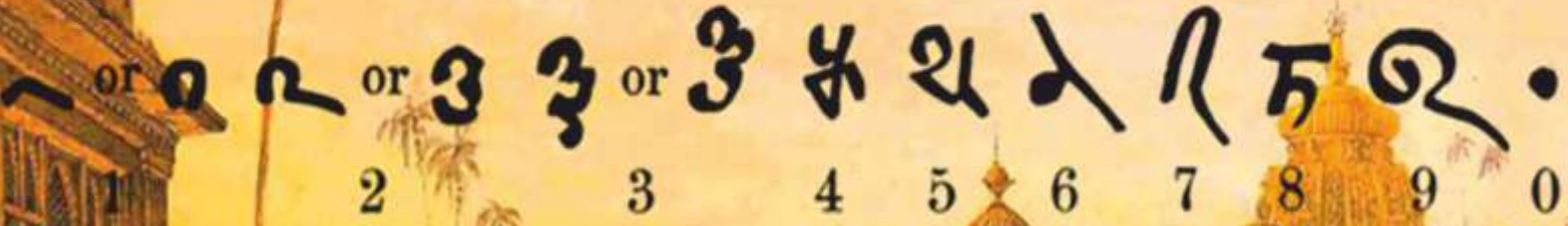
1st Event of the Series - DHARA  
An Ode to Indian Knowledge System

25 February, 2022

**AICTE-Auditorium**

Nelson Mandela Marg, Vasant Kunj, New Delhi-110070





## About Azadi Ka Amrit Mahotsav

Azadi Ka Amrit Mahotsav is an initiative of the Government of India to celebrate and commemorate 75 years of progressive India and the glorious history of its people, culture and achievements. Azadi ka Amrit Mahotsav is an embodiment of all that is progressive about India's socio-cultural, political and economic identity

March 12, 2022 will be one year of celebrating Azadi Ka Amrit Mahotsav. Exactly a year before we started a 75-week countdown to our 75th Independence Day from Sabarmati Ashram with the blessings of the Hon'ble PM.

Since then, our efforts have not only gathered momentum but also reached across a diverse set of target groups and geographies to ensure the commemoration efforts and celebrations become one of the world's largest program of this nature in terms of scope and participation.

With over 15K + programs spread across 28 States, 8 UTs and 150+ countries globally Azadi ka Amrit Mahotsav is well placed to set off India into the Amrit Kaal on the road to India@2047. To enable the same our programming strategy takes into account the overarching role of Culture in enabling a nation to remember the past, celebrate the present and aspire for a better future and reach new heights.

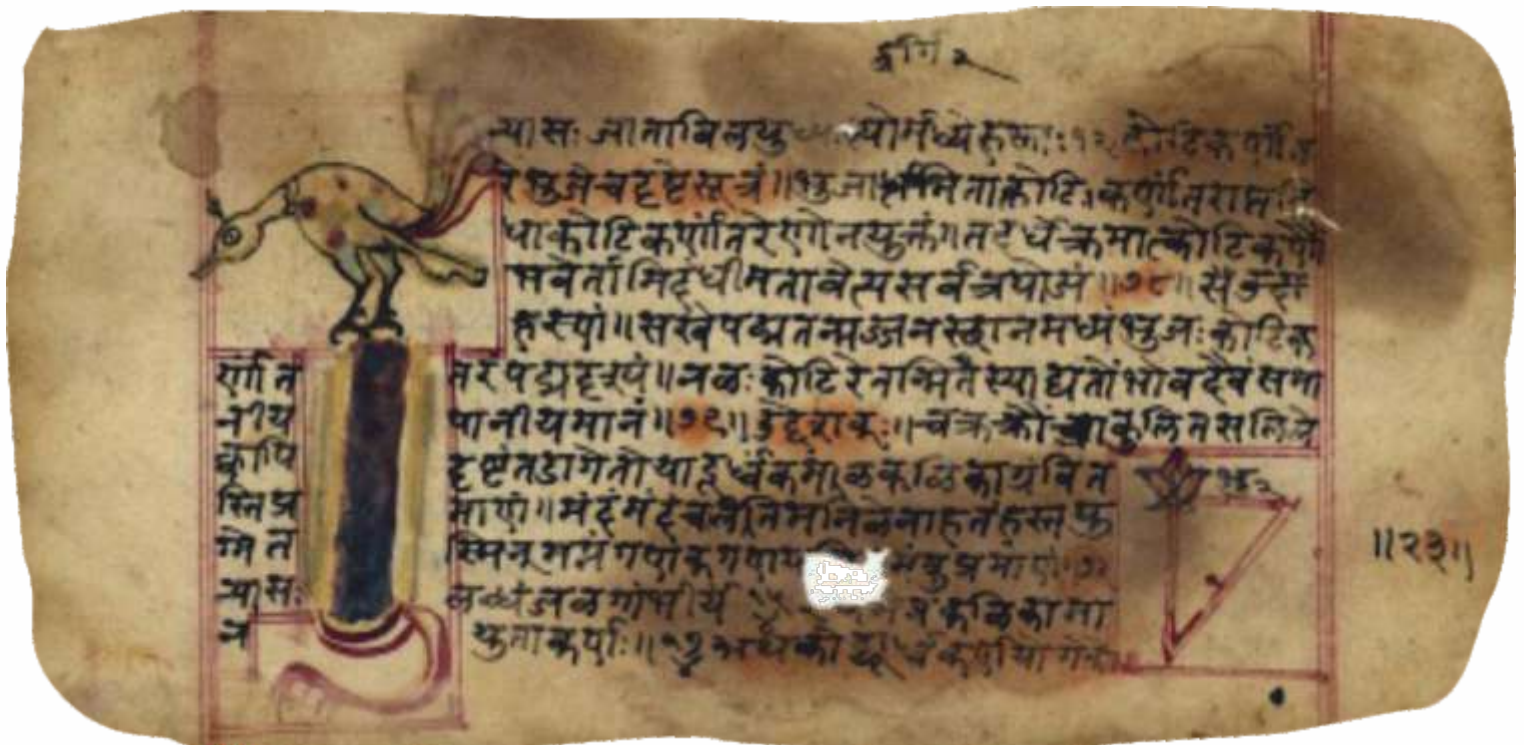


## DHARA

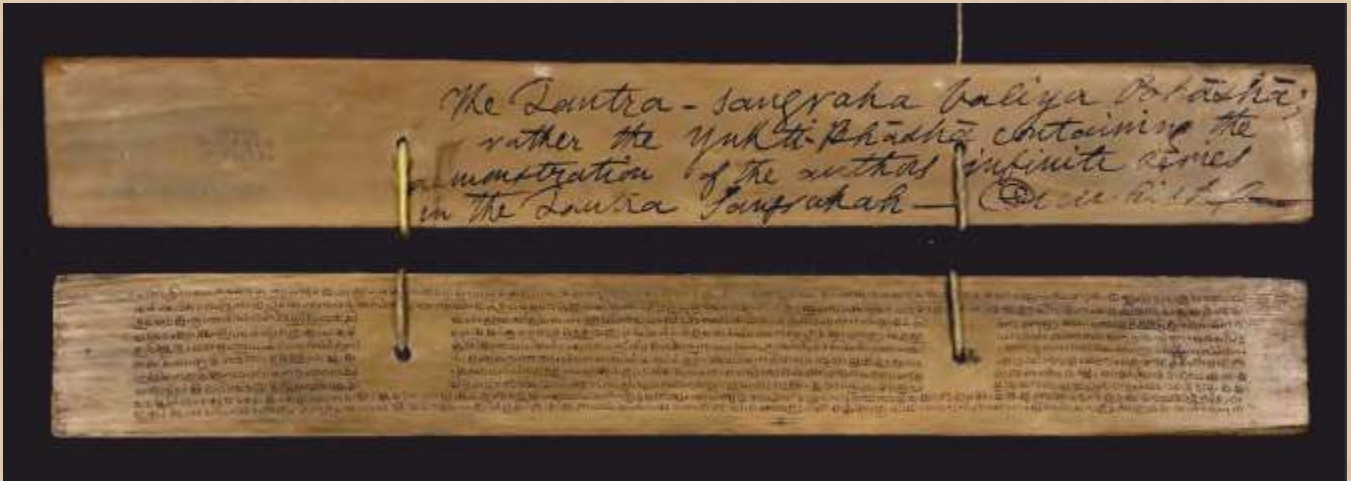
### An ode to Indian Knowledge System

After a prolonged struggle spread over more than 100 years on the back of several movements spearheaded by individuals and communities across the country, India successfully ousted the foreign rulers from the Indian subcontinent in 1947. In true sense, India's freedom movement was a movement by people who were committed to reclaiming their land from the foreign rule. However, as the world's oldest civilisation, this was not the first battle India had fought and won; spread over centuries, the land has witnessed many watershed moments which contributed to its identity. The struggles and successes in ancient India have been critical determinants in shaping the country as we see today.

Therefore, to understand India, it is imperative to familiarise oneself with the social, cultural, economic, religious, geo-political interactions that have taken place, right from the Indus Valley civilisation to Vedic age, Mauryan Empire, Kushans, Guptas, medieval India to East India Company to India's freedom movement, Indo-China relations, liberalisation of Indian economy to present day India known for its cross-industry expertise and wealth creators. To put in perspective, up to the 17th century, India's wealth was close to one-third of the rest of the world combined. Several concepts related to mathematics, science, metaphysics, medicine, astronomy, architecture etc. that are taught today, have their origin in this land that has served as the cradle of human civilization.







The striking diversity across time periods is unified by the common thread called “Bharat”, the land which has witnessed primitive communities evolve into imposing complex social structures, scarcity transform into surplus, crisis convert itself to opportunities and richly woven antiquity be inherited by progressive modernity. For example, civilisations at Dholavira (2600-1900 BCE), Nagarjunakonda (220-320 CE), Nalanda (425-1350 CE), Khajuraho (950-1250 CE), Hampi (1336-1565 CE) and Varanasi (from 800 BCE) continue to dominate our innate lifestyle and manners. Travel accounts by Megasthenes, Faxian, Xuanzang and Yijing, Alberuni, Marco Polo and Francois Bernier convey accounts of lives led by Indians, replete with governance systems, administrative offices, seats of education, art and trade.

India’s journey from the beginning of time is dotted with consequential events, each of which added to the idea of India in a very unique and inevitable manner. For long, these events have been stories limited to folklore or a part of a historian’s collective. It is time we walk down the annals of history and celebrate achievements which we didn’t know belong to India; claim our contribution which innately belongs to Bharat and take forward the continuum of India’s contribution towards making the world a better place for humanity to thrive and coexist.

Dhara: An ode to Indian Knowledge System is a series of programs powered by lecture demonstrations across diverse fields showcasing India’s contribution and achievements. The first event being organised under the aegis of Dhara is dedicated to ‘Mathematics in India’.

It attempts to touch upon India’s fundamental contributions to mathematics, pioneering historians of Indian Mathematics and proposes to cover topics linked to the different ages & schools.

- Ancient Period - Geometry in Śulbasūtras, Piṅgala’s Chandas-śāstra
- Classical Period: Landmarks in Indian Algebra, Jyotpatti, Trigonometry in India, Indeterminate Equations in Indian Algebra
- Kerala School: Mādhava’s Infinite Series for  $\pi$ , Calculus of Trigonometric Functions

# India's Contribution to Mathematics through Ages Program Schedule

## Inaugural Session

10:00 - 10:15	Welcome + Introducing the Theme	
10:15 - 10:30	Address by Chief Guest	
10:30 - 11:05	<b>Manjul Bhargava</b> (Keynote Address)	Beyond Zero: A Survey of Some of India's Fundamental contributions to mathematics
11:05 - 11:10	Vote of Thanks	

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## 11:10 - 11:40 Tea Break

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### Session 1 Ancient Period

11:40 - 12:10	Parthasarathi Mukhopadhyay	Zero & Decimal Place Value System
12:10 - 12:40	Jean Michel Delire	Geometry in Śulbasūtras
12:40 - 13:10	MD Srinivas	Combinatorics in Piṅgala's Chandas-śāstra

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## 13:10 - 14:00 Lunch Break

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### Session 2 Classical Period

14:00 - 14:30	Amartya Kumar Dutta	Some Landmarks in Indian Algebra
14:30 - 15:00	Clemency Montelle	Jyotpatti : Trigonometry in India
15:00 - 15:30	Avinash Sathaye	Indeterminate Equations in Indian Algebra

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## 15:30 - 16:00 Tea Break

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### Session 3 Contributions of Kerala School

16:00 - 16:30	K Ramasubramanian	Mādhava's Infinite Series for $\pi$
16:30 - 17:00	MS Sriram	Calculus of Trigonometric Functions

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## 15:30 - 16:00 Tea Break

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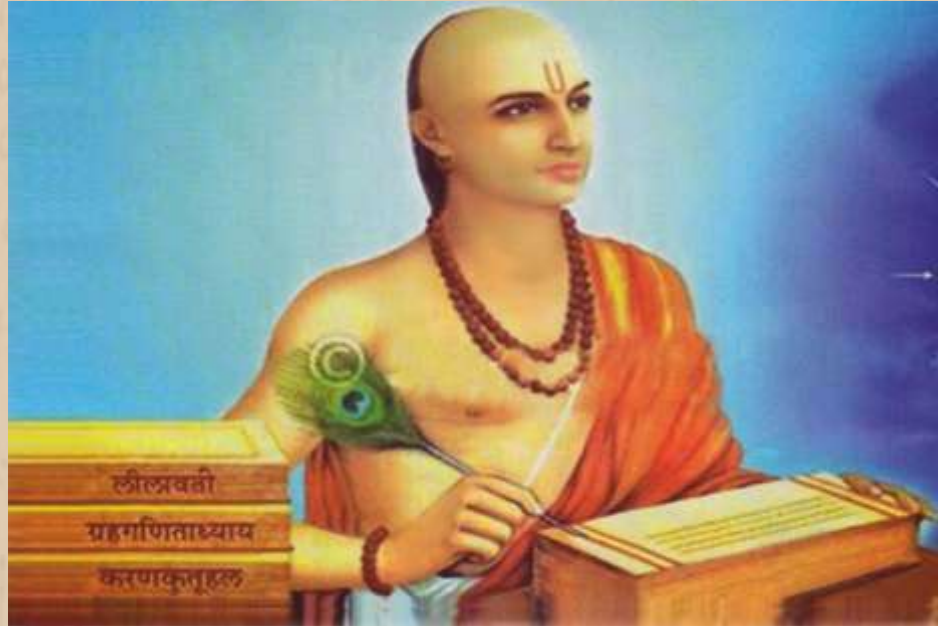
### Session 4 Valedictory Session

17:00 - 17:30	SG Dani	Pioneering Historians of Indian Mathematics
17:30 - 18:00	K Ramasubramanian	Summary & Vote of Thanks

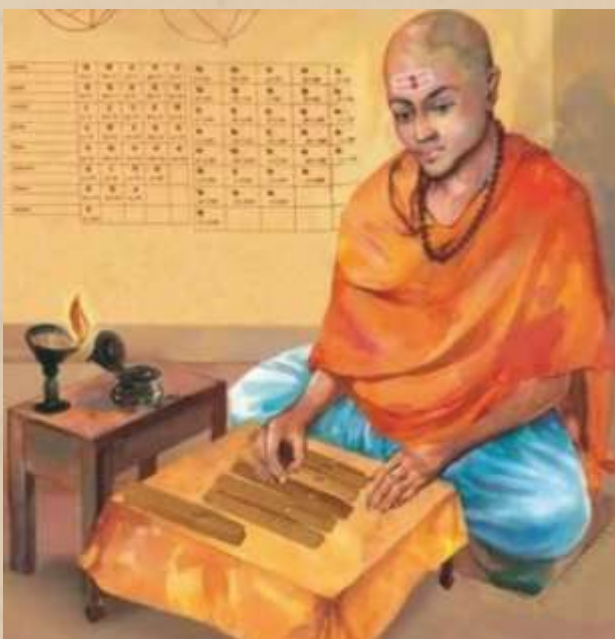


## Mathematics in India: Some Highlights

Mathematics in India has a very rich, long and hallowed history. Starting from the most elementary thing in mathematics namely the representation of numbers, through the way of expressing recursive relations, to arriving at the solutions of indeterminate equations, to the development of sophisticated techniques in handling the infinite and the infinitesimals, Indian mathematicians have made remarkable contributions.

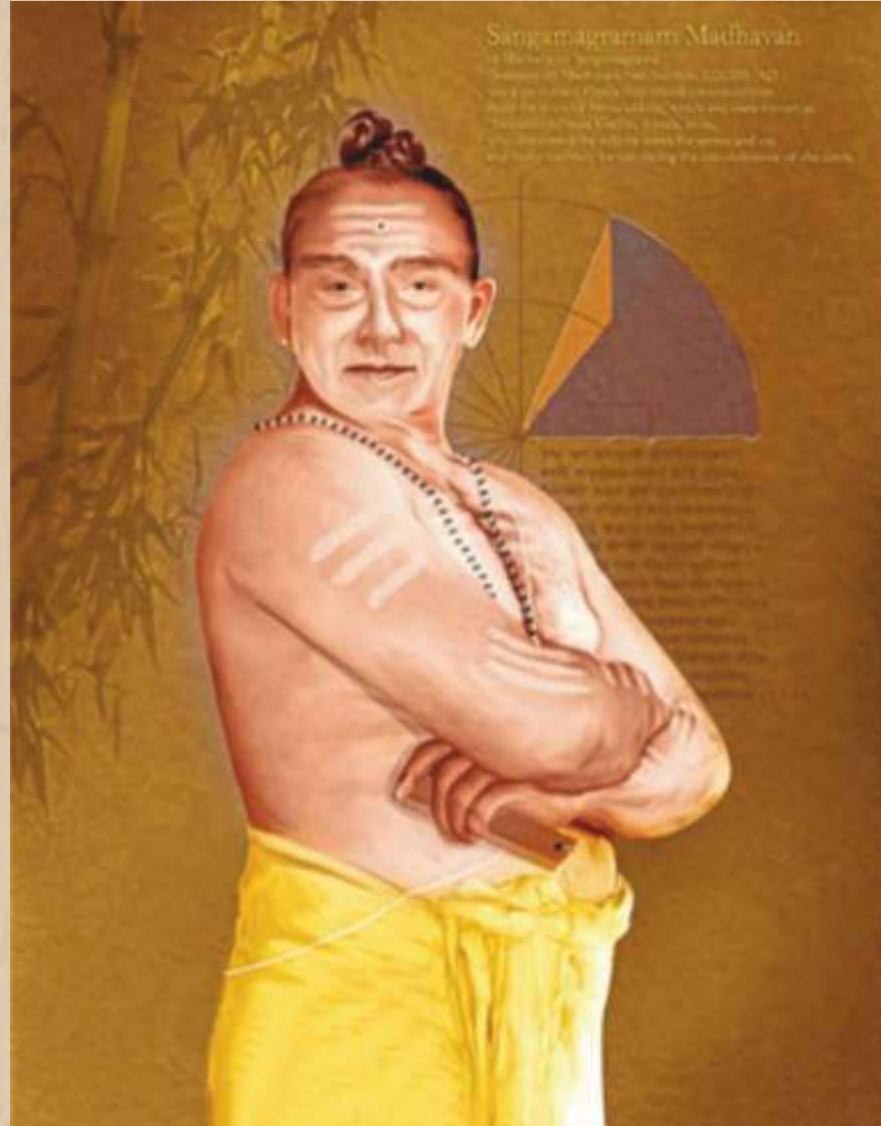


Sulbasutras, the oldest extant texts (~ 800 BCE), explicitly state and make use of the so-called Pythagorean theorem besides giving various interesting approximations to surds. Following this, Pingala's Chandassastra (~ 3rd cent. BCE), a text that deals with the prosody, lays foundations for various combinatorial techniques. By the time of Aryabhata (c. 499 CE), the Indian mathematicians were fully conversant with most of the mathematics that we currently teach in our schools, which include the algorithms for extracting square root and cube root based on the decimal place-value system.



Among other things, Aryabhata also presented the differential equation of sine function in its finite-difference form and a method for solving the linear indeterminate equation. Brahmagupta (c. 628), for the first time in the history of mathematics, fully discusses the arithmetic operations with zero. He also introduces the profound 'bhavana' law of composition for solving quadratic indeterminate equations. Apart from some of these important landmarks in the evolution of arithmetic, geometry, and algebra, significant contributions have also been made in the development of trigonometry.

The Kerala School of astronomy and mathematics pioneered by Madhava (c. 1340–1420) discovered the infinite series for  $\pi$  ( $\pi$ )—the so-called Gregory-Leibniz series—and other trigonometric functions. The series for  $\pi/4$  being an excruciatingly slowly converging series, Madhava also came up with several brilliant fast convergent approximations to it. This School is also credited with the introduction of non-geocentric planetary models. These two things, namely the introduction of infinite series, and non-geocentric planetary models are in fact, hailed as the hallmarks of the genesis of modern science in Europe a few centuries later.



Today, if the modern scholarship is aware of some of these significant achievements of Indians in the development of mathematics, it is primarily because of the dedicated work of few great scholars such as BB Datta, KS Shukla, KV Sarma and so on in the last hundred years. Much of their painstaking work was largely carried out voluntarily, with hardly any support from the institutions of higher learning. Unfortunately, most Indians are not aware of these remarkable contributions made by Indians to the development of mathematics. The series of talks to be delivered by eminent scholars from all over the world, aims to provide a glimpse of this rich mathematical heritage of India.

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