The mentors Digest

2024

JANUARY 2024

ISSUE NO. 08

The mentors Digest

2024

Our Founder and his Vision

Knowledge is the prime wealth among all wealths. In other words, knowledge is the best and important wealth among all wealths. Start your journey to find or explore the knowledge. Our founder and renowned scholar late Padmashri Dr Vellayani Arjunan's vision is to spread quality education to entire community and make it affordable.

Shri. Vellayani Arjunan was born on 10 February 1933 at Vellayani in the erstwhile Kingdom of Travancore. After receiving a Master of Arts degree in Malayalam, he went on to teach Malayalam Language and Literature at Sree Narayana College in Kollam. He later became the first Malayalam lecturer in Aligarh Muslim University, from which he gained his PhD degree in 1964.After leaving Aligarh Muslim University, he was appointed director of the State Institute of Encyclopaedic Publications in Kerala

He was honoured with the Padma Shri award by the nation in 2008. Dr Arjun, who was the first Professor of Malayalam at the Aligarh University and head of the Department of Modern Indian Languages. He supervised 20 research scholars and published more than 100 research papers and articles. He had authored 40 books in different genres including poetry, short story, essays and literary criticism, and his books were prescribed as textbooks in Kerala schools from 1959 onwards.

Degree	Topic	Awarding Institution
D.Litt.	Influence of Sree Narayana Guru on Malayalam Poetry.	Aligarh Muslim University
D.Litt.	A Comparative Study of the Mutual Relations and Uniformity of Hindi and Malayalam Languages.	Agra University
D.Litt.	The influence of Hindi Vocabularies on the South Indian Languages: A Linguistic study.	Jabalpur University
Ph.D.	A Comparative Linguistic Study of Common Vocables of Hindi and Malayalam Languages.	Aligarh Muslim University

Other degrees

Degree	Subject
B.A. Hons	Malayalam Language and Literature
M.A.	Malayalam Language and Literature
M.A.	Hindi Language and Literature
M.A.	Hindi Special
P.G. Diploma	Tamil, Telugu, Kannada

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From the Editor's Desk.....

Dear Students & future leaders,

The country's future lies with its students. In search of direction and inspiration, students seek their families, elders, and teachers for help and inspiration. The year 2023 is over and the world cannot keep calm! 2024 is going to bring new dreams and ambitions and while you plan a wonderful year for yourself, do not forget to thank people who made 2023 a memorable year for you. Take time out to wish them a healthy and prosperous new year.

The start of a new year is more than just the turning of a page; it's a time for everyone to take stock of their lives and make a fresh start. Around the world, the beginning of a new year symbolises a fresh start and a sense of hope, encouraging people to set goals and seize new opportunities.

WHAT IS SPECIAL ABOUT THE MONTH OF JANUARY ?

JANUARY 26 : India's Republic Day, is a momentous occasion that holds deep historical and patriotic significance for the nation. The day commemorates the enforcement of the Constitution of India, which came into effect on January 26, 1950, replacing the Government of India Act (1935). This transition marked India's transformation into a sovereign, socialist, secular, and democratic republic. The Republic Day celebrations are a testament to the enduring spirit of the Indian people and their commitment to democratic principles. The event is marked by various festivities across the country, with the main ceremony held in the capital city, New Delhi.

The highlight of the Republic Day celebrations is the grand parade along Rajpath, showcasing the country's military prowess, cultural diversity, and technological achievements. The parade typically includes colorful tableaux representing different states and union territories, marching bands, and a spectacular display of India's defense capabilities, including the impressive fly past by the Indian Air Force. The ceremony is accompanied by the singing of the national anthem and a 21-gun salute, symbolizing the strength and unity of the nation .Republic Day is not just a day of celebration; it is an occasion for reflection and renewal of the commitment to the principles enshrined in the Constitution.

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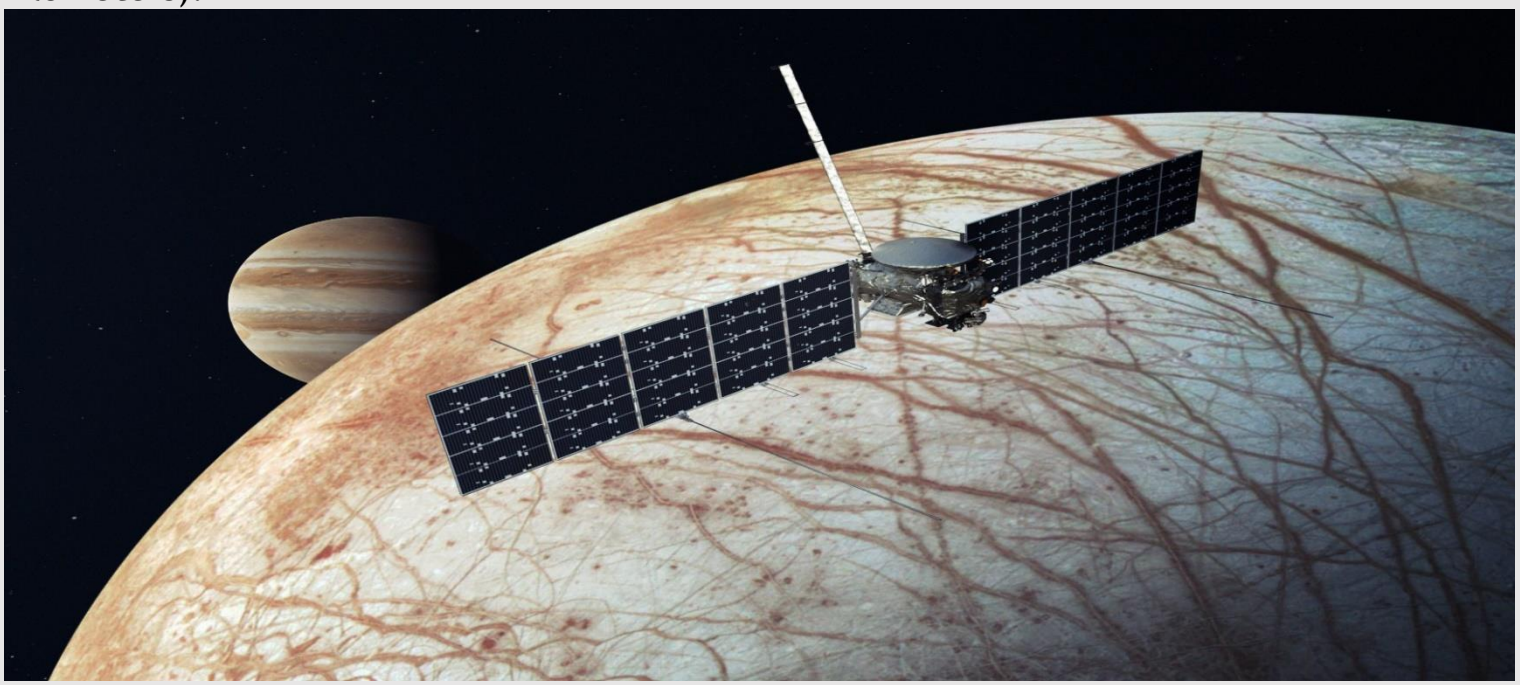
NASA will let you send your name to Jupiter's moon through Europa Clipper spacecraft.

People are invited to engrave their names next to a poem by US poet Ada Limon as part of the "Message in a Bottle" project. The robotic spacecraft Europa Clipper, which runs on solar power, will have microchips with enrolled names laser inscribed on them. With a launch date in October 2024, the spacecraft will travel 1.8 billion miles (2.6 billion kilometers) over the course of around six years, providing a once-in-a-lifetime chance for individuals to participate in interplanetary exploration.

There have been over 700,000 names submitted so far. Once all the names have been collected, technicians at NASA's Jet Propulsion Laboratory in Southern California's Microdevices Laboratory will use an electron beam to stencil them onto a silicon microchip the size of a dime. Every line of text is less than 75 nanometers, or 1/1000th the width of a human hair.

"The chip will be attached to a metal plate engraved with the original poem 'In Praise of Mystery' written by U.S. Poet Laureate Ada Limon to celebrate the mission. Riding on the exterior of the spacecraft, the poem and names will be like a message in a bottle as they make about 50 close flybys of the ocean world," the space agency added.

During these orbits, the mission's research equipment will collect data on Europa's atmosphere, icy crust, and subsurface ocean in an effort to understand whether or not the moon could support life. The mission will travel half-billion miles (800 million kilometers).



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Mathematics

A Triplet Tree Forms One of the Most Beautiful Structures in Math

The article delves into the realm of irrational numbers, specifically focusing on those termed "irrational" due to their inability to be expressed as fractions. While many are familiar with well-known examples like the square root of 2 or pi, the piece emphasizes that irrational numbers are more abundant than rational ones.

The difficulty in approximating irrational numbers with fractions is discussed, noting that larger denominators yield closer approximations. The golden ratio, φ, is highlighted as particularly challenging to approximate. The article then introduces the Markov equation, $x^2 + y^2 + z^2 = 3xyz$, formulated by the Russian mathematician Andrey Markov in 1879. This equation has integer solutions known as Markov numbers, and their significance spans various mathematical fields such as combinatorics, number theory, geometry, and graph theory.

The article explains a fascinating property of Markov numbers, illustrated through a rule: starting with a solution (a, b, c), the related triplet (a, b, 3ab − c) is also a solution. This recursive process creates a branching tree of solutions. Remarkably, the leftmost branch corresponds to the Fibonacci sequence, and the rightmost branch aligns with the Pell sequence.

The narrative then shifts to Georg Frobenius, a German mathematician, who observed a unique property in Markov triples: the largest number in each triplet seemingly uniquely determines the two smaller ones. This observation, known as the uniqueness conjecture, has remained unproven for over a century, presenting a paradox where a seemingly straightforward concept poses a significant challenge.

Recent progress is discussed, particularly in establishing correspondences between Markov triples and fractions, offering hope for a proof of the uniqueness conjecture in the coming years. The article underscores the paradoxical nature of mathematics, where tools like the Markov equation can lead to intricate results while fundamental questions about their properties persist.

CONCEPT MAP

CHAPTER OF THE MONTH:

BINOMIAL THEOREM

Class XI

Expansion

For positive integral index $n \in N$

- $(a+b)^n = {}^nC_0a^n + {}^nC_1a^{n-1}b + ... + {}^nC_nb^n = \sum_{r=0}^{n} {}^nC_ra^{n-r}b^r$

For negative integral index

- $(a+b)^{-n} = \sum_{r=0}^{n} (-1)^n \, {}^nC_ra^{n-r}b^r$

General Term

In the binomial expansion for $(a+b)^n$, general term

- $T_{r+1} = {}^nC_ra^{n-r}b^r$
- T_{r+1} from the end = T_{n-r+1} from the beginning

Middle Term

In the expansion $(a+b)^n$,

- If n is even, then $\left(\frac{n}{2}+1\right)^{th}$ term is the middle term.
- If n is odd, then $\left(\frac{n+1}{2}\right)^{th}, \left(\frac{n+3}{2}\right)^{th}$ are two middle terms.

Binomial Theorem for Fractional Index

For $r \geq 0$, $|x| < 1$ and $n \in Q$

- $(1+x)^n = 1 + nx + \frac{n(n-1)x^2}{2!} + ... + \frac{n(n-1)...(n-r+1)x^r}{r!} + ... + \infty$
- $T_{r+1} = \frac{n(n-1)(n-2)....(n-r+1)}{r!}x^r$
- T_{r+1} in $(1+x)^{-n} = \frac{(-1)^r n(n+1)(n+2)...(n+r-1)x^r}{r!}$
- T_{r+1} in $(1-x)^{-n} = \frac{n(n+1)(n+2)....(n+r-1)x^r}{r!}$

Binomial Coefficients

Greatest Binomial Coefficient are given by

- ${}^nC_{n/2}$, if n is even,
- ${}^nC_{n-1/2} = {}^nC_{\frac{n+1}{2}}$, if n is odd

Coefficient of

- $(r+1)^{th}$ term in $(1+x)^n$ is ${}^nC_r$.
- x^r in $(1+x)^n$ is ${}^nC_r$
- x^r in $(1-x)^n$ is $(-1)^r {}^nC_r$.
- $(r+1)^{th}$ term in $(1-x)^n$ is $(-1)^r {}^nC_r$

Some Important Results

- ${}^nC_r = {}^nC_{n-r}$
- ${}^nC_r = \frac{n}{r} {}^{n-1}C_{r-1} = \frac{n}{r}\left(\frac{n-1}{r-1}\right) {}^{n-1}C_{r-2}$
- ${}^nC_x = {}^nC_y \Rightarrow$ Either $x = y$ or $x + y = n$
- ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$
- $\sum_{r=0}^{n} {}^nC_r = \sum_{r=0}^{n} C_r = 2^n$
- $C_0 + C_2 + C_4 + ... = C_1 + C_3 + C_5 + ... = 2^{n-1}$
- $\sum_{r=0}^{n} r \cdot C_r = n2^{n-1}$
- $C_0^2 - C_1^2 + C_2^2 - C_3^2 + ... + (-1)^n C_n^2 = \begin{cases} 0, n \text{ is odd} \\ (-1)^{\frac{n}{2}} {}^nC_{\frac{n}{2}}, \ n \text{ is even} \end{cases}$
- $C_0 - C_2 + C_4 - C_6 + ... = 2^{\frac{n}{2}} \cos\frac{n\pi}{4}$
- $C_1 - C_3 + C_5 - C_7 + ... = 2^{\frac{n}{2}} \sin\frac{n\pi}{4}$
- If $n = p_1^{\alpha_1}.p_2^{\alpha_2}.p_3^{\alpha_3}....p_r^{\alpha_r}$, where $p_1, p_2, ... p_r$ are prime numbers and $\alpha_1, \alpha_2, ... \alpha_r$ are positive integers. Then sum of positive divisors of $n = (1 + p_1 + p_1^2 + ... + p_1^{\alpha_1})(1 + p_2 + p_2^2 + ... + p_2^{\alpha_2})....(1 + p_r + p_r^2 + ... + p_r^{\alpha_r})$.

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Science & Technology

BREAKTHROUGH : Artificial DNA opens door to designer proteins

DNA, the molecule that stores the genetic information of all living things, is made up of just four chemical letters, or nucleotides. But what if we could add more letters to this alphabet and create new kinds of DNA? That's what a team of researchers from the University of California San Diego, the Foundation for Applied Molecular Evolution, and the Salk Institute for Biological Studies have done. They have developed a new version of DNA with six letters instead of four, showing that it can be used to make proteins, the building blocks of life.

This feat, published in *Nature Communications* , opens doors to a future where custom-designed proteins and novel biological applications could become a reality.

Four nucleotides :

DNA, the blueprint of life, encodes its instructions using just four nucleotides – adenine (A), thymine (T), guanine (G), and cytosine (C). These nucleotides pair in specific configurations, forming the iconic double helix. But what if this alphabet could be expanded ? The implications are compelling, ranging from personalized medicine to revolutionary materials.

Using AEGIS :

AEGIS adds two new letters to the standard DNA alphabet. These letters pair up in a specific way to form the double-helix structure of DNA.

The new letters, Z and P, have the same shape and size as the natural ones, so they can fit into the DNA helix without disrupting its geometry. This means that the enzymes that read and copy DNA, such as RNA polymerase, can recognize and process AEGIS DNA just like natural DNA.

RNA polymerase

The researchers identified RNA polymerase, a key enzyme that converts DNA into RNA, which is then used to make proteins. RNA polymerase readily accepted these novel additions when tested, seamlessly incorporating them into transcription.

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CHAPTER OF THE MONTH:

BRAIN MAP
CLASS XI

COLLISION

CLASSIFICATION OF COLLISON

On the basis of line of impact:

HEAD-ON COLLISION
The velocities of the particles are along the same line before and after the collision.

OBLIQUE COLLISION
The velocities of the particles are along different lines before and after the collision.

On the basis of kinetic energy:

INELASTIC COLLISION
If the kinetic energy after and before collision are not equal, the collision is said to be inelastic.

PERFECTLY INELASTIC COLLISION
If velocity of separation just after collision becomes zero, then the collision is perfectly inelastic.

ELASTIC COLLISION
If the kinetic energy after and before collision is same, the collision is said to be perfectly elastic.

Head on Inelastic Collision

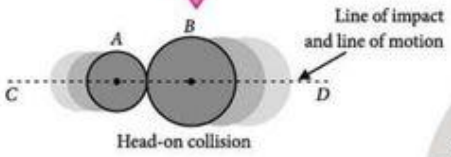
Velocity after collision :

$$v_1 = \left(\frac{m_1 - em_2}{m_1 + m_2}\right)u_1 + \left(\frac{(1+e)m_2}{m_1 + m_2}\right)u_2$$

$$v_2 = \left(\frac{(1+e)m_1}{m_1 + m_2}\right)u_1 + \left(\frac{m_2 - em_1}{m_1 + m_2}\right)u_2$$

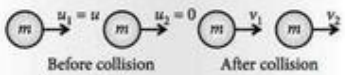
Loss in kinetic energy :

$$(\Delta K) = \frac{1}{2}\left(\frac{m_1 m_2}{m_1 + m_2}\right)(1-e^2)(u_1 - u_2)^2$$



Head-on collision

- **Velocities after inelastic collision :**



$$\therefore \frac{v_1}{v_2} = \frac{1-e}{1+e}$$

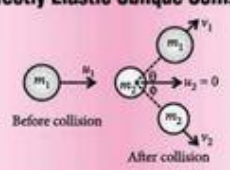
- **Coefficient of Restitution (e)**

$$e = \frac{\text{Velocity of separation along line of impact}}{\text{Velocity of approach along line of impact}}$$

Rebounding of Ball After Collision

- **After first rebound**
  - Speed : $v_1 = ev_0 = e\sqrt{2gh_0}$
  - Height : $h_1 = e^2 h_0$
- **After n^{th} rebound :**
  - Speed : $v_n = e^n v_0$
  - Height : $h_n = e^{2n} h_0$
- **Total distance travelled by the ball before it stops bouncing :**
  $H = h_0[(1+e^2)/(1-e^2)]$

Perfectly Elastic Oblique Collison



After perfectly elastic oblique collision of two bodies of equal masses, the scattering angle $(\theta + \phi)$ would be 90°.

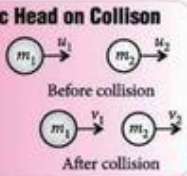
By substituting $e = 1$, we get $\Delta K = 0$

Elastic or Perfectly Elastic Head on Collison

Velocity after collision :

$$v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 + \frac{2m_2 u_2}{m_1 + m_2}$$

$$v_2 = \left(\frac{m_2 - m_1}{m_1 + m_2}\right)u_2 + \frac{2m_1 u_1}{m_1 + m_2}$$



Special Cases

If projectile and target are of same mass
For $m_1 = m_2 \Rightarrow v_1 = u_1$ and $v_2 = u_1$
i.e., their velocities get interchanged.

If massive projectile collides with a light target
For $m_1 >> m_2 \Rightarrow v_1 = u_1$ and $v_2 = 2u_1 - u_2$
Sub case : For $u_2 = 0$, *i.e.*, target is at rest
$v_1 = u_1$ and $v_2 = 2u_1$

If light projectile collides with a heavy target
For $m_1 << m_2 \Rightarrow v_1 = -u_1 + 2u_2$ and $v_2 = u_2$
Sub case : For $u_2 = 0$, *i.e.*, target is at rest
$v_1 = -u_1$ and $v_2 = 0$, the ball rebounds with same speed.

If $m_2 = nm_1$ and $u_2 = 0$
The fractional kinetic energy transferred by projectile

$$\frac{\Delta K}{K} = \frac{4n}{(1+n)^2}$$

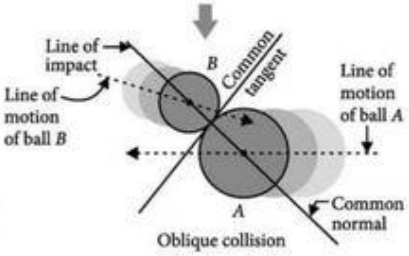
Fractional kinetic energy retained by the projectile

$$\left(\frac{\Delta K}{K}\right)_{\text{Retained}} = 1 - \text{fractional kinetic energy transferred by projectile}$$

In Case of Smooth Surfaces

Common normal :
Force is exerted in common normal direction only. Momentum changes in common normal direction.

Common tangent :
$F = 0$
Neither momentum nor velocity changes in common tangent direction.

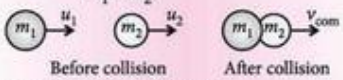


Oblique collision

Perfectly Inelastic Collision

- **When the colliding bodies are moving in the same direction :**

$$v_{com} = \frac{m_1 u_1 + m_2 u_2}{m_1 + m_2}$$



Loss in kinetic energy

$$\Delta K = \frac{1}{2}\left(\frac{m_1 m_2}{m_1 + m_2}\right)(u_1 - u_2)^2$$

- **When the colliding bodies are moving in the opposite direction :**

$$\therefore v_{com} = \frac{m_1 u_1 - m_2 u_2}{m_1 + m_2}$$

Loss in kinetic energy

$$\Delta K = \frac{1}{2}\left(\frac{m_1 m_2}{m_1 + m_2}\right)(u_1 - u_2)^2$$

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TWIST YOUR MIND

(Answers will be given in the February 2024 digest)

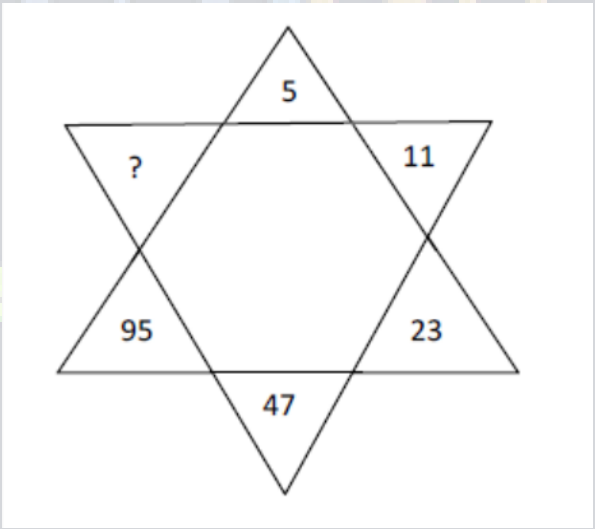
RIDDLES

1. The more you take, the more you leave behind. What am I?

2. Pronounced as 1 letter, And written with 3, 2 letters there are, and 2 only in me. I'm double, I'm single, I'm black blue, and gray, I'm read from both ends, and the same either way. What am I?

PUZZLES

1. Find the missing number.



Bright Spots: Positive Events from December 2023

•Disease elimination: Bangladesh eliminates visceral leishmaniasis, and Iraq eradicates trachoma, demonstrating progress in combating global health challenges.
•Closer to Alzheimer's cure: Research advances offer hope for potential Alzheimer's treatment, benefiting millions affected by the disease.
•Renewable energy on the rise: Increased use of solar, wind, and other renewable sources strengthens the path towards a cleaner future.
•Positive climate tipping points: Studies show progress in climate change efforts, offering hope for a turning point in environmental protection.
This list highlights just a few of the positive developments in December 2023. These stories remind us of the human spirit's capacity for innovation, compassion, and resilience, inspiring hope and optimism as we face the future.

DECEMBER ANSWERS

RIDDLES: 1. Are you asleep ? 2. Nine .**PUZZLE**: Read every row as follows:(3 + 2) x 2 = 10(1 + 9) x 2 = 20(0 + 8) x 2 = 16(7 + 5) x 2 = 24

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2023 Year in Review

From cultural events that dominated headlines to geopolitical shifts and clashes, what were the events that defined 2023?

- Geopolitics
- Economics
- Technology
- Cultural Event

JAN

8th: China opens borders, ending zero-COVID policy.

23rd: Microsoft invests $10B into OpenAI, extending partnership.

FEB

4th: Chinese "spy balloon" drifts over the Americas.

21st: Russia suspends participation in nuclear arms reduction treaty.

MAR

10th: SVB collapse and banking turmoil.

19th: UBS buys Credit Suisse for $3.2B.

APR

4th: Finland named 31st NATO member, doubles NATO-Russia border.

15th: Germany closes nuclear plants, ends 50 years of nuclear power.

MAY

5th: WHO declares end of COVID-19 global emergency.

6th: Coronation of King Charles III.

word of the month

Meraki : a Greek word meaning to do something with soul, creativity, or love; to put something of yourself in your work.

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2023 Year in Review

JUN

18th: Titan submarine goes missing while exploring Titanic site.

23rd: Wagner Group begins conflict with Russian military.

JUL

14th: SAG-AFTRA announces strike.

July is the hottest recorded month for global average surface air temperature.

AUG

8th: Hawaiian wildfires burn 17,000 acres, killing over 100.

24th: BRICS to add Argentina, Ethiopia, Egypt, Iran, UAE, and Saudi Arabia in 2024.

SEP

1st: Novo Nordisk overtakes LVMH as Europe's largest company.

15th: United Auto Workers begin strike.

OCT

7th: Attacks on Israel and start of Israel-Hamas war.

13th: Microsoft closes acquisition of Activision Blizzard.

NOV

15-17th: Xi Jinping meets Biden in first U.S. visit since 2017.

17-21st: Sam Altman fired and reinstated as CEO of OpenAI.

DEC

13th: COP28 agrees on transition away from fossil fuels.

19th: Shipping firms suspend Red Sea activity after Houthi militants' attacks.

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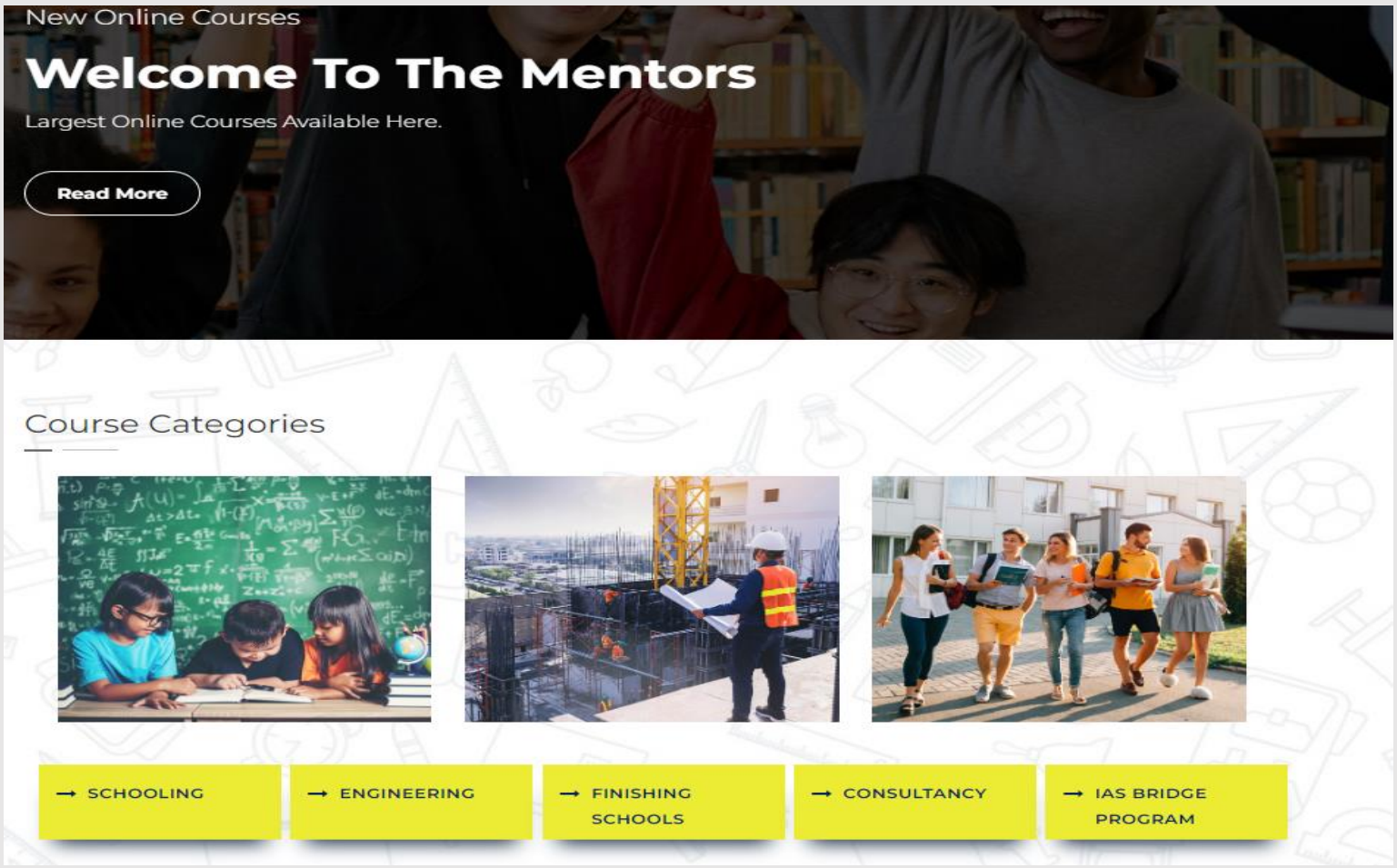
The Mentors website launched , please log onto **www.thementors.co.in**



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MAGAZINES

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ABOUT US

Affordable Quality education …….

By understanding the need of aspiring students, India's renowned Academic experts in the field of school education- Mr. Jayasankar Prasad (Son of **Late Padmasree Dr Vellayani Arjunan** and former Director Vivekananda group of schools) and Ms. Chitra Jayasankar (Educational advisor, Tagore Educational trust) are there to bridge the gap of ensuring quality education for the students. We have formulated an online platform for providing significantly exceeding educational experience through online tuitions (classes 8-12), IAS bridge programs and finishing school for fresh engineers and other professionals. We will ensure excellent learning experience to students and 100% satisfaction level to parents.

Interested parents who are willing to associate with this concept are requested to contact

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