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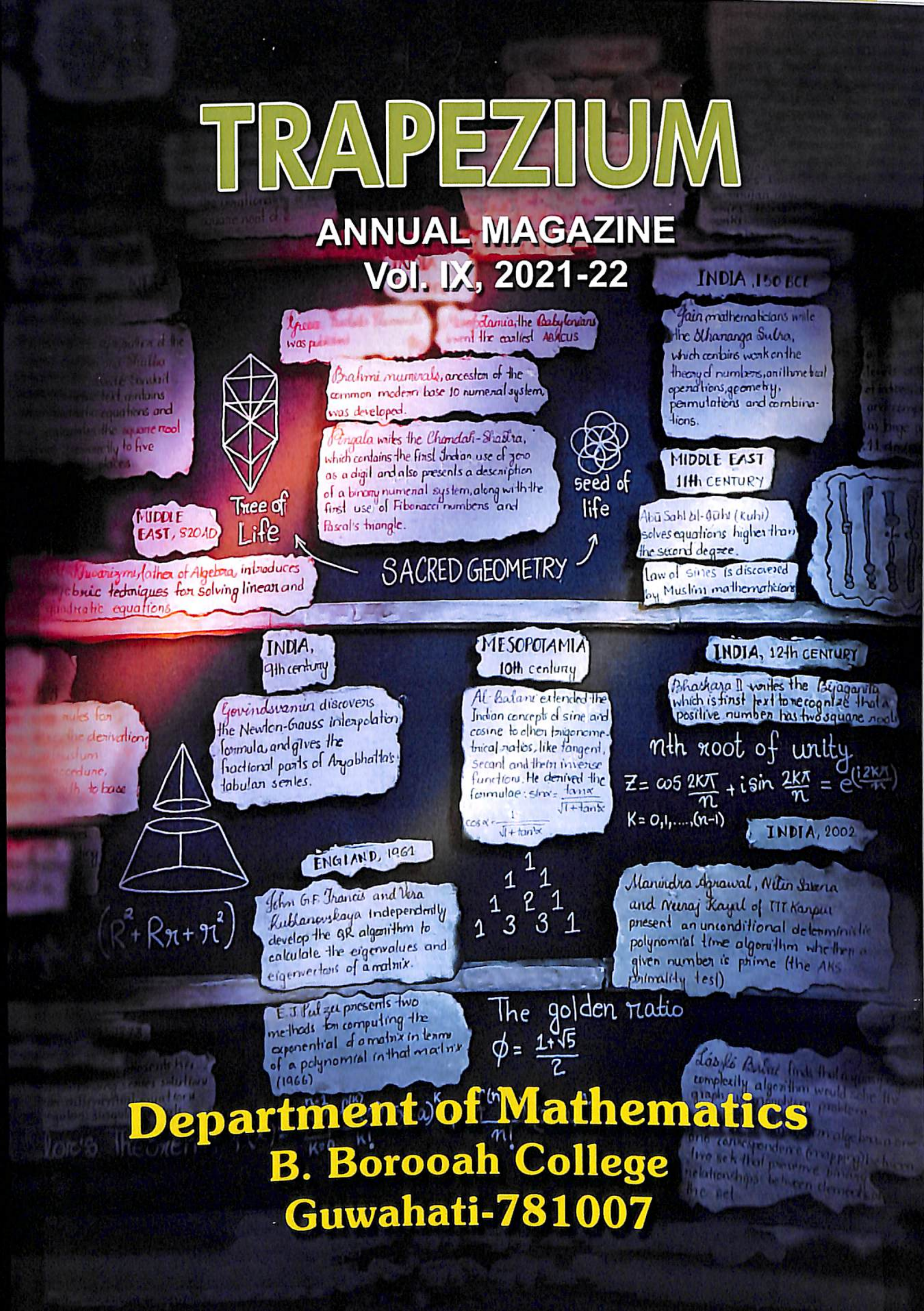

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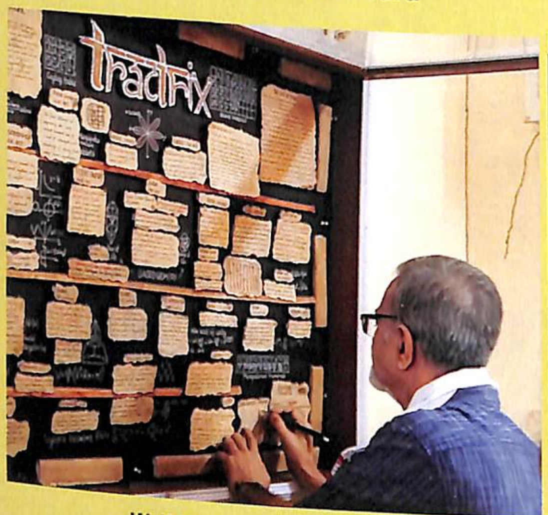

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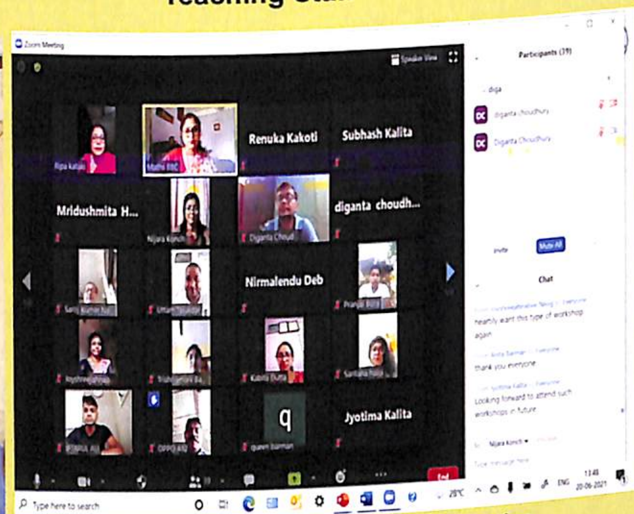

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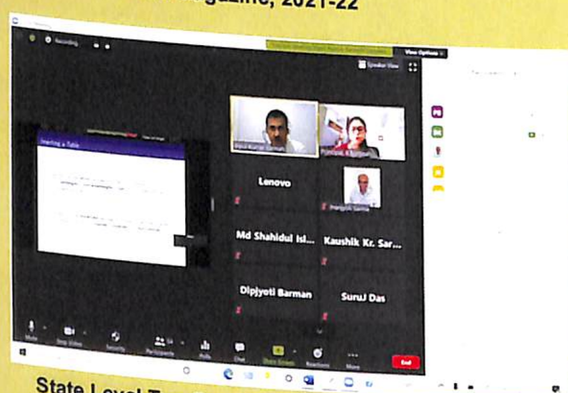

State Level Two Days Workshop on LaTeX, 2021

Pi Day Celebration, 2021

Ramanujan Day Celebration, 2021

Annual Lecture Programme, 2021

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সম্পাদকীয়

কিতাপ বা আলোচনী যিয়েই নহওঁক, ই একো একোখন দাপোনৰ লেখীয়া। আমাৰ এই আলোচনীখনো আমাৰ বিভাগৰ দাপোন। দৈনন্দিন জীৱনত গণিতৰ ব্যাৱহাৰক লৈ বিভিন্ন সময়ত খুহুতীয়াভাৱে হ'লেও বিভিন্ন প্ৰশ্ন উত্থাপন হোৱা আমাৰ পৰিলক্ষিত হয়। কিন্তু আমি প্ৰতিদিন প্ৰতিনিয়ত গণিত অবিহনে আগবাঢ়িব নোৱাৰোঁ। এই কথাষাৰৰ প্ৰমাণ আমি 'ট্ৰেপিজিয়াম'ৰ প্ৰতিটো পৃষ্ঠাত উপলব্ধি কৰিব পাৰিম। গণিতক কেৱল মাত্ৰ দৈনন্দিন জীৱনৰ কথাৰ মাজতে আৱদ্ধ নাৰাখি বিশ্ব ব্ৰহ্মাণ্ডৰ গণিতকেন্দ্ৰিক যি কথা বতৰা, ঘটনা তাৰ এক সামগ্ৰিক চিত্ৰ আমি আমাৰ আলোচনীখনত দেখিবলৈ পাইছোঁ। গণিতৰ কথাৰ পৰা ফালৰি কাটি আমি গদ্য তথা পদ্য সাহিত্যৰ ৰঙো কিছু পৰিমাণে সানিবলৈ যত্ন কৰিছোঁ। কিমান দূৰ সফল কিমান দূৰ বিফল এই কথা পৰৱৰ্তী সময়ত আমি আপোনালোকৰ পৰা নিশ্চয়কৈ জানিবলৈ আশা কৰিম।

সম্পাদক হিচাপে আমাৰ অভিজ্ঞতা তেনেই নতুন। এখোজ দুখোজকৈ খোজ দিছোঁহে মাত্ৰ। তথাপি আমাৰ ওপৰত যি বিশ্বাস আৰু আস্থা ৰাখি এই দায়িত্ব আগবঢ়াই দিছে তাৰ বাবে বিভাগৰ ওচৰত চিৰ কৃতজ্ঞ। আলোচনীখন সম্পাদনাৰ ক্ষেত্ৰত অজানিতে হোৱা ভুল ক্ৰটিবোৰ ন-শিকাৰু হিচাপে আপোনালোকে মাফ কৰিবলৈ অনুৰোধ জনালোঁ। অনাগত দিনত আপোনালোকৰ দিহা-পৰামৰ্শই 'ট্ৰেপিজিয়াম'ক এক নতুন দিশ দি নতুন পথেৰে আগবঢ়াই নিব বুলি আশা ৰাখিলোঁ।

চাহিদুল ইছলাম
ভাবনা শৰ্মা
সম্পাদকদ্বয়

বি. বৰুৱা কলেজ অধ্যক্ষৰ কাৰ্যালয় ঃ গুৱাহাটী-৭, অসম
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No. BBC/ ***Date : ....***

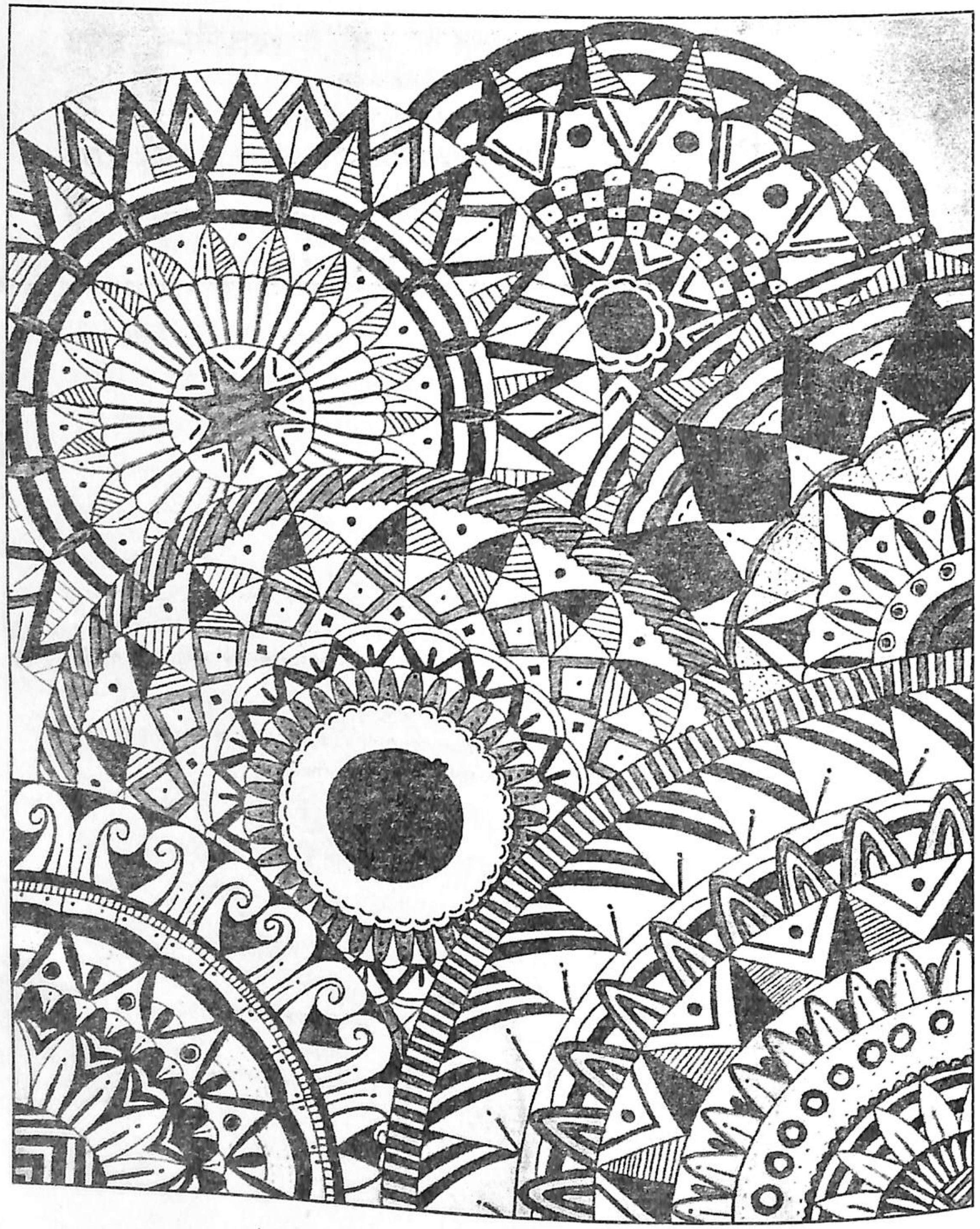
Message

It is a matter of sheer delight that keeping up with the Pi-day, the Department of Mathematics, B. Borooah College, is going to publish its annual magazine "*TRAPEZIUM*". I congratulate the faculty members and students of the department for their efforts and wish that this magazine will be informative and resourceful.

I convey my best wishes to all the noble endeavors of the Department of Mathematics and hope the "*TRAPEZIUM*" will be immensely beneficial to all concerned.

Date: 11.03.2023

(Dr. Satyendra Nath Barman)
Principal
B. Borooah College



Art by : **Sunaina Begum**, 2nd Sem., Department of Mathematics

Application of Congruences

Dr. Ripa Kataki
Associate Professor, Department of Mathematics

"Mathematics is the queen of sciences and number theory the queen of Mathematics"

– C. F Gauss

In the world of Mathematics, the theory of numbers always plays a significant role. The divisibility theory in the integer is based on the Division Algorithm which asserts that if an integer 'a' is divided by a positive integer 'b' the reminder is greater than equal to zero and less than b. If the remainder zero then we call 'b' divides 'a'. Another approach for handling the divisibility theory of integers is the concept of congruence. It is a very powerful tool which is based on arithmetic of remainders. The notion of congruence and the symbol '≡' to represent it, was first introduced by German Mathematician "Carl Fredrick Gauss" in his book "DisquisitionesArithmeticae" in 1801 when he was 24 years old. Since then, the theory congruence laid the foundation of modern number theory.

Let n be a fixed positive integer.Integers 'a' and 'b' are said to be congruent modulo n

if n divides a-b. It is written as $a \equiv b \pmod{n}$.If ndivides (a-b), then $a-b = nq$, $q \in Z$, which

implies that $a = nq+b$ i.e. b is the remainder when a is divided by n, $0 < b < n$.

We now discuss some interesting applications of congruence.

The clock arithmetic for 12-hour clock is based on congruence modulo 12.

What will be the time in such a clock 4 hours after 12 o' clock?

The required time will be 4 o'clock as $12+4 \equiv 4 \pmod{12}$.

Similarly, 3 hours after 10 o'clock will be 1 o'clock as $10+3 = 12+1 \equiv 1 \pmod{12}$

Now a days all of we are aware about the identification code ISBN of a book. The notion of congruence is used to detect errors in strings of digit which are used to identify a book. The ISBN of a book is a coded 10-digit numerical levels. For example, the ISBN of the book 'Elementary Number Theory' by David M. Burton is 0-07-061607-8. There are 4 blocks in this number 0, 07, 061607 and 8. The last block is 8 and this number is called the check digit. With the help of the check digit publishers, book sellers can detect an incorrect ISBN.

We can find the check digit of an ISBN (if it is missing or wrongly typed) of a book using congruence as follows:

Consider an incomplete ISBN 0-07-061607- ? of a book where check digit is missing.

First the digits are labeled as $x_1 x_2 x_3 x_4 \ldots\ldots x_9 x_{10}$ where each x_i for $i = 1, 2, 3\ldots..9$ is one of the digits 0,1, 2, 3, 4, 5, 6, 7, 8, 9.

The check digit x_{10} has eleven possible values 0, 1,2,3,4,5,6,7,8,9,10. But 10 is a two-digit number so it will be replaced by X.

Thus, the possible check digit for an ISBN is 0, 1, 2,3,4,5,6,7,8,9, X.

Then we determine x_{10} by the congruence $1.x_1 + 2.x_2 + 3.x_3 + 4.x_4 + 5.x_5 + 6.x_6 + 7.x_7 + 8.x_8 + 9.x_9 + 10.x_{10} \equiv 0 \pmod{11}$

$\Rightarrow 1.0 + 2.0 + 3.7 + 4.0 + 5.6 + 6.1 + 7.6 + 8.0 + 9.7 + 10.x_{10} \equiv 0 \pmod{11}$

$\Rightarrow 21 + 30 + 6 + 42 + 63 + 10\, x_{10} \equiv 0 \pmod{11}$

$\Rightarrow (-1) + (8) + 6 + (-2) + (-3) + (-1).\, x_{10} \equiv 0 \pmod{11}$

$\Rightarrow x_{10} \equiv 8 \pmod{11}$

Therefore, the required check digit is 8 and hence the above ISBN is the book "Elementary Number Theory" by Burton.

Again,take another ISBN 81 - 20?- 0871 - 9 in which one digit indicated with a question mark is not readable due to printing issue. To find it proceed as follows:
Let the missing digit be x_5.

Then, $1.8 + 2.1 + 3.2 + 4.0 + 5.x_5 + 6.0 + 7.8 + 8.7 + 9.1 + 10.\,9 \equiv 0 \pmod{11}$

$\Rightarrow 227 + 5x_5 \equiv 0 \pmod{11} \Rightarrow 5x_5 \equiv -7 \pmod{11}$

But $0 \le x_5 \le 9$, Therefore, $x_5 \equiv 3 \pmod{11}$

Thus, the complete ISBN is 81-203-0871-9.

Now discuss an application of congruence is sports.

A Round-Robin tournament is a tournament of n different teams where each team will play against each team exactly once.

The teams are labeled as 1, 2, 3....... n. It is a difficult task to make a time table for the tournament. But with the help of the congruence, we can do it easily as follows:

First the teams are labeled as 1, 2, 3....... n. The team i will play against the team j in the kth round if $i + j \equiv k \pmod{n}$.

For example, if there are 5 teams for a Round - Robin Tournament, they are labeled as 1, 2, 3, 4, 5. By the rule $i+j \equiv k \pmod{n}$ we have for the first round i.e., for k = 1,

$1+5 \equiv 1 \pmod{5}$, $2+4 \equiv 1 \pmod{5}$, $3+3 \equiv 1 \pmod{5}$

i.e., Team 1 plays against team 5

Team 2 plays against team 4

Team 3 plays against team 3

Here team 3 plays against team 3 means that team 3 draws a bye in the 1st round.

For the 2nd round, i.e., for k = 2,

$1+1 \equiv 2 \pmod{5}$, $2+5 \equiv 2 \pmod{5}$, $3+4 \equiv 2 \pmod{5}$

In this round team 1 gets a bye, team 2 plays with team 5, team 3 plays with team 4 etc.

Similarly we can construct time tables for 3rd round, 4th round & 5th round.

Thus, with the help of concept of congruence we can design a time table for a Round-Robin Tournament for large number of teams.

These are only some examples of applications of the notion of congruence. There is plethora of such applications of congruence everywhere. It fascinates us to solve real life problem easily. ■

- There are just four numbers known so far (besides 1) which are the sum of the cubes of their digits:-
  $153 = 1^3+5^3+3^3$
  $370 = 3^3+7^3+0^3$
  $371 = 3^3+7^3+1^3$
  $407 = 4^3+0^3+7^3$
- 2520 is the smallest number that can be exactly divided by all the numbers between 1 to 10
- 60 is the smallest number that can be exactly divided by all the numbers between 1 to 5
- 25 is the sum of five consecutive single digit odd natural numbers 1, 3, 5, 7, 9.

The Mystery of 3, 6, 9 Number: A Fascinating Exploration

Rishav Upadhyay

4th Sem., Department of Mathematics

Have you ever heard about the mysticism of numbers? Throughout history, certain numbers have been imbued with special significance, and 3, 6, and 9 are no exception. These numbers have been the subject of numerous philosophical, spiritual, and scientific theories, and their properties have intrigued many scholars and enthusiasts.

The first thing that stands out about these numbers is that they all share a common denominator: 3. In numerology, 3 is considered a sacred number that represents creativity, growth, and abundance. Therefore, it's no surprise that multiples of 3, such as 6 and 9, are believed to carry similar properties.

One of the most famous proponents of the mystical properties of these numbers was Nikola Tesla, the renowned physicist and inventor. Tesla was fascinated with the idea that 3, 6, and 9 held the key to understanding the universe's fundamental principles. According to Tesla, "If you only knew the magnificence of the 3, 6, and 9, then you would have a key to the universe."

So what makes these numbers so special? Let's take a closer look at each one

Three is the first odd prime number and the only number that is both a triangular number and a Fibonacci number. In mathematics, a triangular number is a number that can be represented as a triangle, while a Fibonacci number is a sequence of numbers in which each number is the sum of the two preceding numbers. Three is also significant in many religions, such as Christianity, where it represents the Holy Trinity.

Six is the first perfect number, meaning that it is the sum of its divisors (1, 2, and 3). It is also a composite number, meaning that it is not a prime number. In many cultures, six is associated with harmony and balance.

Nine is the last single-digit number and is considered a mystical number in many cultures. It is the only number that, when multiplied by any other number, always returns a sum that adds up to 9. For example, 9 x 2 = 18, and 1 + 8 = 9. In Buddhism, nine is a sacred number that represents spiritual awakening.

Many theories have been proposed about the significance of these numbers, such as their relationship to geometry, physics, and spirituality. Some even believe that they hold the key to unlocking the secrets of the universe.

While there is no concrete evidence to support these claims, the fact remains that 3, 6, and 9 continue to fascinate and intrigue people. Whether you believe in their mystical properties or not, there is no denying that these numbers are more than just digits on a page. They represent something greater, something that we may never fully understand.

In conclusion, the mystery of 3, 6, and 9 is an intriguing topic that has captivated people's imaginations for centuries. While their significance may be open to interpretation, there is no denying that these numbers hold a special place in our collective consciousness. Who knows, maybe one day we will uncover the true meaning behind these mystical digits and unlock the secrets of the universe. ■

- 9 is said to be magic number because if you multiply a number with 9 and then sum up all the digits to resulting numbers, the sum will always come up to be 9.

  Example- 2×9=18=1+8=9

  17×9= 153=1+5+3=9

- The number 4 is black hole number because the word FOUR has 4 letters, and so THREE has 5 letters. Now count the no. of letters in 5. So FIVE has 4 letters. This is also applicable in other words too.

Cryptography

Dr. Anjana Bhattacharya
HoD & Associate Professor
Department of Mathematics

Cryptography is confined to diplomatic and military practices in making and breaking of secret codes. With the growing quantity of digital data stored and communicated by electronic data processing systems, organizations in both the public and commercial sectors have felt the need to protect information from unwanted intrusion. The widespread use of electronic funds transfers has made privacy a pressing concern in most financial transactions. There has been a recent surge of interest by mathematicians and computer scientists in cryptography (Kryptos- bidden, Graphein - to write). It is the science of making communications unintelligible to all except authorized parties. Cryptography is the only known practical means of protecting information transmitted through public communications, networks, such as those using telephone lines, microwaves or satellites.

In cryptography codes are called *ciphers* and the information to be concealed is called *plaintext*. After transformation to a secret form, a message is termed as *ciphertext*. The process of converting from plain text to ciphertext is said *Encrypting* or *Enciphering*, while the reverse process of changing from ciphertext back plain text id *decrypting*.

One of the earliest cryptographic systems was used by the Great Roman Emperor Julias Caesar around 50 B.C. Caesar wrote Marcus Cicero using a rudimentary substitution cipher in which each letter of alphabet is replaced by the letter which occurs three places down the alphabet, with the last three letters cycled back to the first three letters. If we write the ciphertext equivalent underneath the plaintext letter, the substitution alphabet for the Caesar cipher is given by:

Plain text	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Cipher text	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C

Let us consider a plaintext message :
(1) 'START OPERATION'

The Ciphertext of this message is:
(2)'VWDUW RSHUDWLRQ'
The plaintext message can also be transformed to ciphertext by using congruence theory.

characters	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
digits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

If "P" is the digital equivalent of plaintext letter and "C" is the digital equivalent of the corresponding ciphertext letter, then

$C = P + 3 \pmod 6$

Now,

(1) and (2) becomes

19 20 01 18 20 15 16 05 18 01 20 09 15 14
22 23 04 21 23 18 19 08 21 04 23 12 18 17

Of course due to the simplicity of the Caesar Cipher Caesar himself abandoned the scheme feeling insecurity from it. In conventional cryptographic systems the sender and receiver jointly have a secret key. The sender uses the key to encrypt the plaintext to be sent, while the receiver uses the same key in order to decrypt the ciphertext obtained. Public key cryptography is different from conventional cryptography where the sender and receiver use two different keys : encryption key and decryption key. A major advantage of a public key crypto- system is that it is unnecessary for each sender and receiver to exchange a key in advance of their decision to communicate with each other.

In 1977, R. Rivest, A Shamir and L. Adleman proposed a public key encrypto-system which uses only elementary ideas from number theory. Their enciphering system is called RSA after the initials of the inventors. Its security depends on the assumption that in the current state of computer technology, the factorization of composite numbers with large prime factors in prohibitively time consuming.

In the RSA system each user chooses a pair of distinct primes, p and q. The factorization of their product $n = pq$ is called enciphering modules. One might take p and q with 200 digits each, so that n has roughly 400 digits. Having selected n, the user then chooses a random positive integer k, the enciphering exponent, satisfying $\gcd(k, \varphi(n)) = 1$. The pair (n, k) is placed in public file, analogous to a telephone directory, as the user's personal encryption key. This will allow anyone else in the communication network to encrypt and send a message to that individual. While n is openly revealed, the listed public key does not mention the factor s p and q of n.

The encryption process begins with the conversion of the message to be sent into an integer M by means of a 'digital alphabet' in which each letter, number, or a punctuation mark of the plaintext is replaced by two digit number. One standard procedure is to use the assignment:

A to Z : 01 to 26
, = 27 , . =28 , ?= 29 , 0 = 30
1= 31 , 2 = 32 , 3=33 , 4= 34 , 5= 35 , 6= 36 , 7= 37 , 8 = 38 , 9 = 39 , ! = 40
and 00 indicating a space between two words.

Let us consider a message :
'Check the road'
It is transformed to numerical string :
M=0308050311002008050018150104

Looking up the intended the intended recipient's encryption key (n,k) in the public dictionary ; the sender disguises the plaintext number M as a ciphertext number r by raising M to the K th power and then, reducing the resultant modulo n ; that is :

$$M^K \equiv r \pmod{n}$$

Where n is the enciphering modules.

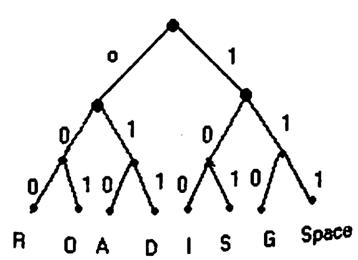
Use of Binary tree:

Suppose we wish to represent the message 'ROAD IS GOOD' using code. We wish to encode the message. Let us select the code C ={0,1,00,10,01,11,100,001,000} to represent the symbols { R, O, A, D, I, S, G, Blank Space} respectively. Thus encoding ' ROAD IS GOOD' we get the string of 0's and 1's as

(01,00,100) 000 (11,100,01,00,1,1,10)

We do not know where the spaces between words occur, and when we see, for instant, if we brake the above message as
we get,
(I, A, G) space (S, G, I, O, O, D)
i.e., IAG SGIAOOD

Now we can use binary trees to construct prefix codes . Starting from the root at each vertex we label the arc going to the left by 0 and the one going to right by 1.



If we now label the leaves of the binary tree by symbols we ant code words, we can obtain a prefix code for these symbols by recording the labels on the arcs in the path from the root to each leaf. Hence the leaves of the tree are labelled by R, O, A, D, I, S, G, and space. In each space can be written as 111. Thus the prefix code we drive using the binary tree is :

	O	A	D	I	S	G	Space
000	001	010	011	100	101	110	111

Using these code words to encode our message we get the string
000001010011111100101111110001001011. ■

"I believe that mathematics when conceived in its broadcast sense , is an indispensable tool in a complex world"

-Newton

জীৱনৰ হাতপুথি

অনামিকা বড়া
ডিমৌ, শিৱসাগৰ

"নদীৰ পানী যেনেকৈ লেথাৰি ধৰি আহি আছে, গৈ আছে আৰু সেই দেখি পানীৰ এটা সোঁত পৰিছে, সেইদৰে জীৱবিলাকো লেথাৰি ধৰি, মাজত শূন্য নোহোৱাকৈ আহি আছে গৈ আছে আৰু সেই দেখি জীৱৰ এটা সোঁত পৰিছে। এই সোঁতটোক সাধাৰণ কথাত মানুহে সংসাৰ বোলে।" সত্যনাথ বৰাৰ "সাৰথি" নামৰ পুথিখনৰ 'মনুষ্য জীৱনৰ লক্ষ্য' পাঠটিৰ অন্তৰ্গত বাক্যটি সকলোৰে পৰিচিত। এই সংসাৰ সোঁতক পশুসুঁতি,গজনসুঁতি আৰু মনুষ্যসুঁতি — তিনিভাগত ভাগ কৰি মনুষ্যক প্ৰথম দুইৰ পৰা পৃথক হিচাপে দেখুৱাইছে। লগতে তেওঁ এক চমু অথচ সাৰগৰ্ভ বৰ্ণনা দিছে জীৱশ্ৰেষ্ঠ মনুষ্যৰ প্ৰধান লক্ষ্য সম্বন্ধে। বহু বিষয়ত স্বাধীন মনুষ্যই নিজ বুদ্ধি বা জ্ঞানেৰে ভাল বেয়া, যুগুত-অযুগুত আদি বিবেচনাৰে সংসাৰৰ উদগতি সাধন কৰা উচিত। এতিয়া কথা হ'ল অতীজৰে পৰা বৰ্তমানলৈকে মানুহৰ জ্ঞান-বিজ্ঞান আৰু বস্তুবাদী সংস্কৃতিৰ চৰম বিকাশ হোৱা সত্বেও হিংসাৰ তাণ্ডৱ আৰু ৰক্তপাত বাঢ়ি আহিছে। সংসাৰৰ উদ্‌গতিত বৈ যোৱা আঁসোৱাহটো তেন্তে কি? জ্ঞানৰ সমন্বিতে প্ৰজ্ঞাৰ সাধনা কৰিবলৈ পাহৰি যোৱাটোৱে ইয়াৰ মুখ্য কাৰণ যিটোৰ বিষয়ে এক যুক্তিযুক্ত বিশ্লেষণ পোৱা যায় হোমেন বৰগোহাঞিৰ "প্ৰজ্ঞাৰ সাধনা" গ্ৰন্থখনিত। পঁচিশ বছৰ পূৰ্বে ৰচিত হ'লেও মুঠ চৌবিশটি প্ৰবন্ধৰ গ্ৰন্থখনিৰ গুৰুত্ব সাম্প্ৰতিক সময়তো অকণো কমা নাই।

সংসাৰত উদ্‌গতি সাধন কৰিবলৈ হ'লে আমি দুয়ো প্ৰকৃতিকে জয় কৰিব পাৰিব লাগিব। জ্ঞানেৰে বহিঃপ্ৰকৃতিক আৰু প্ৰজ্ঞাৰে অন্তঃপ্ৰকৃতি অৰ্থাৎ মনটোক জয় কৰিব পাৰিলেহে প্ৰকৃত উন্নতি হয়। প্ৰজ্ঞা মানেনো কি? জ্ঞানৰ সৈতে ইয়াৰ সম্পৰ্ক কি? আমি, আধুনিক মানুহে জ্ঞান আৰু প্ৰজ্ঞাৰ মাজত থকা পাৰ্থক্যটো পাহৰি দুয়োটাকে এক কৰাটোৱেই এক ডাঙৰ ট্ৰেজেডী বুলি লেখকে আক্ষেপ কৰিছে। অতি সহজতে এই পাৰ্থক্যটো বুজিবলৈ লেখকে আগবঢ়োৱা উদাহৰণকেইটাৰ এটা হৈছে, "ধন ঘটিবলৈ আমাক বুদ্ধি বা জ্ঞান লাগে কিন্তু সজ কামত সেই ধন খৰচ কৰি জীৱনত প্ৰকৃত অৰ্থত সুখী হ'বলৈ আমাক লাগে প্ৰজ্ঞা।" সেইবাবে জ্ঞানৰ সমানেই প্ৰজ্ঞাৰ সাধনাৰ অতীৱ প্ৰয়োজন। প্ৰজ্ঞাৰ অৰ্থৰ পৰা আৰম্ভ কৰি ইয়াৰ প্ৰয়োজনীয়তা, গুৰুত্ব, গভীৰতা সম্বন্ধে বিশদভাৱে লেখকে আলোচনা আগবঢ়াইছে গ্ৰন্থখনৰ প্ৰথম প্ৰবন্ধ 'প্ৰজ্ঞাৰ সাধনা'ত।

উল্লেখযোগ্য যে গ্ৰন্থখনৰ প্ৰতিটো প্ৰবন্ধই আপাতত সুকীয়া বিষয়বস্তুৰ। তথাপিও কোনো পুনৰাবৃত্তি নোহোৱাকৈ প্ৰবন্ধসমূহক একেলগে ইটোৰ পিছত সিটোৰ মাজত এনেভাৱে নিৰ্বাচন আৰু সংযোগ কৰিছে যে পাঠকৰ মনত সৃষ্ট প্ৰবন্ধৰ কিতাপৰ বিষয়ে তথাকথিত বিৰক্তিৰ ইয়াত নামমাত্ৰও স্থান নাই। লগতে অনন্য

গদ্যশৈলী, প্ৰাঞ্জল বৰ্ণনা, বস্তুনিষ্ঠ প্ৰকাশভঙ্গী আৰু প্ৰয়োজনীয় বিষয়বস্তুও ইয়াৰ অন্যতম কাৰক। জীৱন সম্পৰ্কে বিভিন্ন কোণেৰে আলোচনা কৰা গ্ৰন্থখনত সামাজিক আৰু অৰ্থনৈতিক দিশসমূহৰ উপযুক্ত বিশ্লেষণো মন কৰিবলগীয়া। প্ৰতিটো প্ৰবন্ধই নৈতিক দিশকো সামৰি গৈছে। ঠায়ে ঠায়ে আগবঢ়োৱা নিৰ্মোহ আৰু বাস্তৱিক সমালোচনাৰ সমান্তৰালকৈ পাঠকৰ সন্মুখত দাঙি ধৰিছে বিবিধ চিন্তাৰ পথ। কেতবোৰ পুঞ্জীভুক্ত প্ৰশ্নৰ উত্তৰ দি পঢ়ুৱৈক লৈ গৈছে অন্য কিছু প্ৰশ্নৰ মাজলৈ যিবোৰে মুকলি কৰিব ন-চিন্তাৰ দুৱাৰ, ন-সৃষ্টিৰ পথাৰ।

মাত্ৰ কেইটামান বাক্যত গ্ৰন্থখনৰ আটাইবোৰ প্ৰবন্ধৰ বিষয়ে আলোচনা কৰিবলৈ অধমৰ ধৃষ্টতা নাই। সেয়ে লেখকৰ বিচক্ষণ কলমেৰে নিগৰিত বাকী প্ৰবন্ধসমূহ উল্লেখ কৰি দিছোঁ- স্বাস্থ্যৰ সাধনা; খোজ কঢ়াৰ বিষয়ে; প্ৰকৃতিৰ দান; গদ্যৰ বিষয়ে কিছু চিন্তা ভাৱনা; বেঞ্জামিন ফ্ৰেংকেলিনৰ জীৱনত গদ্য; অভিধান, ব্যাকৰণ, মনুষ্যত্ব ইত্যাদি; অসমত আধুনিকতাৰ অগ্ৰদূতঃ হেমচন্দ্ৰ বৰুৱা; বাংলাৰ অপভ্ৰংশ হ'বলৈ অসমীয়া ভাষাৰ বেছি দিন নাই; অসমীয়াৰ দৃষ্টিত বাঙালী; মুছলিম মানসিকতা; বাঘ; কবি; নাদৰ ভেকুলী; বুলেট আৰু বেলট; হিংসা; বিপ্লৱ আৰু সন্ত্ৰাসবাদ; মানুহৰ ভৱিষ্যত; আত্মহত্যাৰ পথ; সময়ানুবৰ্তিতা আৰু শিষ্টাচাৰ; অতীত, বৰ্তমান, ভৱিষ্যত; চেঁচামাত এটা দিন; আচলতে কোনে কৈছিল আৰু কি কৈছিল; জীৱন-মৃত্যু। কিতাপখন পঢ়ি উঠি নিঃসন্দেহে ক'ব পাৰি যে জীৱন পথৰ প্ৰয়োজনীয় জ্ঞানৰ বছা বছা মণি-মুকুতাক একেলগ কৰি "প্ৰজ্ঞাৰ সাধনা" মালাডালেৰে লেখকে পঢ়ুৱৈক বান্ধি ৰাখিব পাৰিছে। মূল বিষয়বস্তুৰ পৰা ফালৰি নকটাকৈ বিভিন্ন ব্যক্তি আৰু সাহিত্যৰ উদ্ধৃতি কিতাপখনৰ আন এক সৌন্দৰ্য। আনুষংগিক দিশসমূহৰ উপস্থাপন কেৱল পৰিমিত আৰু সুখপাঠ্যই নহয়, এইবোৰে পঢ়ুৱৈকো বিশ্বসাহিত্য তথা ব্যক্তিৰ সৈতে পৰিচয় কৰোৱাত বিশেষ ভূমিকা গ্ৰহণ কৰে। থোৰতে সকলো দিশ সামৰি "প্ৰজ্ঞাৰ সাধনা" গ্ৰন্থখনি জীৱন-শিক্ষাৰ বাবে এখন নিৰ্ভৰযোগ্য হাতপুথি বুলিলেও অত্যুক্তি কৰা নহ'ব কিয়নো সংসাৰ সাগৰত সাঁতুৰিবলৈ শিকোৱা গ্ৰন্থ আমাৰ জীৱনৰ অন্যতম সমল।

জন্মিলে মৃত্যু অনিবাৰ্য। এই সত্য জনাতকৈ উপলব্ধিৰ প্ৰয়োজন। বাস্তৱ অভিজ্ঞতাৰ আধাৰত বৰ্ণিত শেষৰটো প্ৰবন্ধ 'জীৱন-মৃত্যু'ত লেখকে তাকে বুজাবলৈ উত্থাপন কৰিছে টলষ্টয়ৰ 'আইভান ইলিচৰ মৃত্যু' গল্পটোৰ প্ৰসংগ। সেই গল্পটোৱে তেখেতক জীৱন আৰু মৃত্যুক নতুন পোহৰত চাবলৈ সহায় কৰাৰ কথা উল্লেখ কৰি কিতাপখন শেষ কৰিছে এটা প্ৰশ্নবোধক বাক্যৰে — "তথাপি 'আইভান ইলিচৰ মৃত্যু' পঢ়াৰ পিছত আপোনাৰ নিজৰ জীৱনটো পৰীক্ষা কৰি চাবলৈ আপোনাৰ মন যাব; সামান্য ভাব-অনুভূতি থকা মানুহ হ'লেই আপুনি নিজকে প্ৰশ্ন কৰিব- 'আমি জীৱনৰ কিমানখিনি সময় আচলতে জীয়াই থাকোঁ? জীয়াই থকা বুলিলে আমি আচলতে কি বুজোঁ?" আৰু গ্ৰন্থখনিৰ সাৰমৰ্মও তাতেই নিহিত হৈ আছে। ■

Mathematics is an Art!

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Introduction :

Many of you might be wondering or nodding their head like how mathematics is an art or an art form and not science. Well bear with me in this and I hope you'll get a slight idea of what I'm about to present!

To answer the question, "How Mathematics is an art?", we have to know what 'Art' means. Well, 'Art is an expression or an urge to create constructions which externalize internalized inputs from the environment. In simple words, it is a medium to express how the environment responses.

Mathematics has itself been described as art motivated by beauty; more precisely by symmetry! But Mathematics is usually classed with Sciences, both in official catalogues and in popular imagination. But the subject matter is very different.

Subject Matter :

The sciences are about things in the real world. It is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Each science has its own area with some overlap. For example, Physics is about things like forces, mass, stars and subatomic particles. Chemistry is about atoms and molecules. Biology is about living things, etc.

But the average educated adult has virtually no idea what Mathematics is about or about what Mathematicians do. This is because of how math is taught and how its teaching differs from how the sciences are taught. In high school chemistry, the students do something like chemistry. They mix chemicals together and see what happens. So, what do Mathematicians do? They invent and prove theorems. These theorems are not anything in the real world, rather they are about abstract things such as numbers, shapes, sets, functions and many other things. Much of the Mathematics is about things that are so abstract that non-specialists don't even have the knowledge and vocabulary to understand what those things mean. For example, its easy to define prime numbers. They are positive integers greater than 1 that are divisible

TRAPEZIUM

only by 1 and themselves. But what about 'numbers?' It's very tricky to define them and we've never seen one. Of course, we have seen representation of numbers as 1, 2, 3, ... But these are not the numbers but merely symbols of the numbers. Botanists study apples, psychologists study people, mathematicians study numbers and they don't even exactly exist.

Goals :

Mathematics is the pursuit of a certain kind of beauty, a highly abstract structured beauty. It's like poetry. A sonnet should be beautiful, but it also has to follow a specific rhyme scheme and scansion. Similarly, a mathematical theorem should be beautiful, but you also have to prove it (and proofs can be beautiful too).

Here, math is more like art than a science. Mathematicians are always seeking new theorems and more beautiful proofs of theorems, just as artists seek new forms of art and more beautiful expressions of old forms.

Inevitability :

It is possible to imagine a universe with different physical laws. Indeed, many physicists believe that there are many universes and that the physical laws differ between them. And some science fiction writers have also written about such universes. But it is much more difficult, if it is even possible, to imagine a world with different mathematics.

We can imagine a universe where (say), the gravitational constant is higher or lower. But can we imagine a universe in which 3 is not a prime? There are various philosophers of mathematics, just as there are various philosophers for art or beauty or ethics or whatever. Platonists believe that mathematical truth exists in some ideal world- that there are 'forms' or ideal representations of mathematical objects. Formalists such as Zoltan P Dienes believe that math is a game played with symbols. Realists believe that mathematical objects exist in the regular world. But, regardless of your philosophy of math, it seems impossible to imagine a universe where the integers behave differently. Any species that has integers will know that 3 is prime and 4 is not. That's why it is the truest art form that exists.

And as Albert Einstein said, "Pure Mathematics is, in it's way, the poetry of logical ideas. And its essence lies in its freedom." So be free to paint your mathematical canvas!

পদাৰ্থ বিজ্ঞানৰ ভাষা 'গণিতৰ কথা'

ৰাজদ্বীপ তালুকদাৰ
ষষ্ঠ ষান্মাসিক, পদাৰ্থ বিজ্ঞান বিভাগ

১৭ শতিকাৰ এগৰাকী মহামানৱ তথা মহান বিজ্ঞানী গেলিলিও গেলিলিয়ে কৈছিল, **"Mathematics is th elangeoge in which God has written the universe."**

অৰ্থাৎ এই মহাবিশ্বৰ ভাষা হ'ল গণিত। ই অতিৰঞ্জিত মুঠেই নহয় বা কোনো কাব্যিক কল্পনাও নহয়। ই ধ্ৰুৱ সত্য। এক গভীৰ উপলব্ধি। দৈনন্দিন জীৱনৰ ব্যস্ততাত এনেবোৰ মহাসত্যৰ অৱলোকন সহজ নহয়। যদিওবা ইয়েই দিয়ে আমাক এটি বিশেষ অৰ্থ। বিশাল বিশ্বব্ৰহ্মাণ্ডত নিজৰ অৱস্থিতি উপলব্ধি কৰাৰ অৰ্থ।

গণিতক বিজ্ঞানৰ ৰাণী বুলি কোৱা হয়। এই উপমাতিয়েই যথেষ্ট, এই মহাজগতৰ বিশালতাত গণিতৰ আধিপত্য তথা শ্বাশ্বত অৱস্থিতিৰ কথা বুজাবলৈ। বিশেষকৈ পদাৰ্থ বিজ্ঞানৰ ক্ষেত্ৰত এই কথা বেছিকৈ উপলব্ধি কৰিব পাৰি। সেয়েহে কোৱা হয়, দুয়োটা একেটা মুদ্ৰাৰ ইপিঠি-সিপিঠি। কাৰণ, পদাৰ্থ বিজ্ঞানে কথা কয়, গণিতৰ ভাষাত। প্ৰকৃতিৰ নিয়মসমূহ প্ৰকাশ কৰিব পাৰি কেৱল এটা মাথো সমীকৰণৰ সহায়ত। ই মানৱতাৰ এক অনন্য সফলতা। ইয়াতেই এটা বৰ গভীৰ প্ৰশ্নৰ উদয় হয়। গণিত 'উদ্ভাৱিত' নে 'আৱিষ্কৃত'? কোনো কোনোৰ মতে 'উদ্ভাৱিত' আৰু কোনো কোনোৰ মতে 'আৱিষ্কৃত'। মোৰ বোধেৰে দুয়োটাই। কাৰণ গণিত হ'ল প্ৰকৃতিত থকা বিভিন্ন বিমূৰ্ত চানেকিৰ মূৰ্ত উপস্থাপন। নিয়ম বা চানেকিবোৰ ইতিমধ্যেই প্ৰকৃতিত বিদ্যমান। আমি কেৱল কিছুমান চিহ্নৰ জৰিয়তে সেইবোৰক উপলব্ধিৰ প্ৰয়াস কৰিছো। নিয়ম বা চানেকিবোৰ আৱিষ্কৃত আৰু চিহ্ন বা সমীকৰণবোৰ তথা সাংখ্যিক মানবোৰ উদ্ভাৱিত আৰু এই দুয়োটাই সামৰি গণিতশাস্ত্ৰৰ অৱস্থিতি।

যিহেতু পদাৰ্থ বিজ্ঞানৰ ভাষাই গণিত, সেয়ে পদাৰ্থ বিজ্ঞানত আমি সদায় নিয়মবোৰ কিছুমান সমীকৰণলৈ ৰূপান্তৰিত কৰো। একোটা সমীকৰণেই মাত্ৰাৰ বিভিন্নতালৈ প্ৰৱেশ কৰে। অৰ্থাৎ ই সৰ্বব্যাপ্ত হৈ আমাক আকৌ এবাৰ সূচায় যে, গণিত সাৰ্বজনীন, চিৰতৰুণ আৰু সাতোৰঙীন। উদাহৰণ স্বৰূপে পৃথিৱীৰ সবাতোকৈ বিখ্যাত সমীকৰণটো, $E = MC^2$ য'ত 'E' মানে হ'ল শক্তিৰ পৰিমাণ, 'M' হ'ল ভৰ আৰু 'C' হ'ল শূন্যত পোহৰৰ গতি। এই সমীকৰণটো এই কাৰণেই ইমান গুৰুত্বপূৰ্ণ যে, পূৰ্বতে পৃথক বুলি ভাবি থকা 'ভৰ' আৰু 'শক্তি' সত্তা তথা ৰাশি দুটা পৃথক নহয়। এটাক আনটোলৈ পৰিৱৰ্তন কৰিব পাৰি। এই সমীকৰণটোৱেই ভৰ আৰু শক্তিৰ পৃথকভাৱে থকা সংৰক্ষণৰ সূত্ৰ দুটাক একেলগ কৰিলে। আকৌ, পৰমাণু বোমাৰ আঁৰতো এই সমীকৰণটোৱেই কাম কৰে। এই বোমাৰ বিধ্বংসী ক্ষমতাৰ বাবেই ই মহান বিজ্ঞানী এলবাৰ্ট আইনষ্টাইনক এটা সময়ত বৰ বিষণ্ণ কৰি তুলিছিল, যি আছিল এই সবাতোকৈ বিখ্যাত সমীকৰণটোৰ উদ্ভাৱক। আকৌ, গৱেষণা কৰি এয়াও গম পোৱা গৈছে যে পৃথিৱীৰ মহান ভাৰতীয় গণিতজ্ঞ শ্ৰীনিবাস ৰামানুজনৰ কিছুমান সমীকৰণে পদাৰ্থ বিজ্ঞানৰ এটি বৰ জনপ্ৰিয় আৰু গভীৰ ৰহস্য 'কৃষ্ণগহ্বৰ' (Black Holes)ৰ কথাও বিশ্লেষণ কৰিব

পাৰে। ই এক অমোঘ সাফল্য। যি ৰামানুজনক বিশেষকৈ আমি চিনি পাওঁ তত্ত্বীয় গণিতজ্ঞ হিচাপে। কিন্তু তেওঁৰ বিস্ময়কৰ সমীকৰণবোৰে ব্যৱহাৰিক গণিতৰ ক্ষেত্ৰত ইমান মূল্যবান অৱদান এটি আগবঢ়াই থৈ গৈছে। আকৌ 'Chaos Theory' ৰ কথা আমি ল'ব পাৰো। প্ৰকৃতিত ঘটি থকা যাদৃচ্ছিক যেন লগা বিভিন্ন পৰিঘটনাৰ মাজতো চানেকি বিচাৰি, সেইবোৰক গণিতীয় সংজ্ঞা দিয়াৰ যি প্ৰয়াস, যি জ্ঞান, যিয়েই সহজ অৰ্থত 'Chaos theory' (বিশৃংখল তত্ত্ব)। এয়াও মানৱ সভ্যতাৰ অন্য এক মাইলৰ খুটি। শব্দ বিজ্ঞানৰ ক্ষেত্ৰতো গণিতৰ এটা শাখাৰ বহুল প্ৰয়োগ হয়। সেয়া হ'ল 'ঘাতাংক' (Logarithm)। শব্দৰ তীব্ৰতা বুজাবলৈ এইবিধ স্কেলৰ সহায় লোৱা হয়। তলত দিয়া ধৰণে ইয়াক উপস্থাপন কৰা হয় — $P = 10^{\frac{Lp}{10dB}} P_0$

য'ত 'P' হ'ল জুখিবলগীয়া ক্ষমতা আৰু 'P_0' হ'ল প্ৰাসংগিক (Reference) ক্ষমতা, Lp মানে হ'ল P/P_0 আৰু 'dB' মানে 'decibel' শব্দৰ তীব্ৰতাৰ একক। গণিত আৰু পদাৰ্থ বিজ্ঞানৰ ঘনিষ্ঠতা আৰু এখোপ উপলব্ধি কৰিবলৈ আমি ১৭ শতিকাৰ তথা পদাৰ্থ বিজ্ঞানৰ ইতিহাসত অন্যতম সবাতোকৈ জনপ্ৰিয় মহান বিজ্ঞানী ছাৰ আইজাক নিউটনৰ গতিৰ দ্বিতীয় সূত্ৰটোৰ কথাই ল'ব পাৰোহক। সূত্ৰটো হৈছে —

$$\vec{F} \propto \frac{d(\vec{p})}{dt}$$

য'ত $\vec{F}$ হৈছে বস্তু এটাৰ ওপৰত প্ৰয়োগ কৰা বল, $\vec{p}$ হৈছে বস্তুটোৰ ভৰবেগ ($= m\vec{v}$) আৰু $\frac{d(\vec{p})}{dt}$ হৈছে, সময় সাপেক্ষে ভৰবেগৰ অৱকলজ অৰ্থাৎ এটি মুহূৰ্তত, সময়সাপেক্ষে বস্তুটোৰ ভৰবেগৰ পৰিৱৰ্তন। গতিকে দ্বিতীয় সূত্ৰটোৱে সূচায় যে, বস্তু এটাৰ ওপৰত প্ৰয়োগ কৰা বল তাৰ ভৰবেগৰ পৰিৱৰ্তনৰ সমানুপাতী আৰু বল প্ৰয়োগ কৰা দিশত পৰিৱৰ্তনশীল। এই সূত্ৰটোকেই আচলতে গতিৰ প্ৰকৃত সূত্ৰ বুলি গণ্য কৰা হয়। কাৰণ, এই সূত্ৰটোৰ দ্বাৰাই নিউটনৰ গতিৰ আন দুটা সূত্ৰ উপলব্ধি কৰিব পাৰি। ইয়েই আকৌ এবাৰ প্ৰমাণ কৰিলে যে গণিত সাৰ্বজনীন আৰু সৰ্বকালীন। গ্ৰীচৰ মহান গণিতজ্ঞ, ৫৭০ খ্ৰীঃপূঃত জন্ম লাভ কৰা পাইথাগোৰাছে কৈছিল - "Number rules the Universe". ইও এক চিৰসত্য কথা। ইয়াক সহজভাৱে হৃদয়ংগম কৰিবলৈ আমি আজিৰ কথাকে ল'ব পাৰো। বৰ্তমান মানুহ এজনৰ পৰিচয় বহন কৰিবলৈ কিমানখন যে কাৰ্ড বহন কৰিব লাগে, PAN Card, Aadhar Card, Voter ID Card, Driving Licence Card, ID Card আদি। এইবোৰত লিপিবদ্ধ হৈ থকা বিভিন্ন ডাঙৰ ডাঙৰ সংখ্যাৰ বিপৰীতে আমাৰ পৰিচয় চৰকাৰৰ হাতত মজুত থাকে। এই কাৰ্ডবোৰতো আকৌ নিহিত হৈ থাকে পদাৰ্থ বিজ্ঞানৰ বিভিন্ন সূত্ৰ। অৱশ্যে এয়া এক হাস্যমধুৰ উপলব্ধিহে। কথাযাৰ এনেদৰেই অতি সহজতে উপলব্ধি কৰিব পাৰি। আকৌ, বিভিন্ন ধ্ৰুৱকবোৰ যেনে - π (=3.14....); C ($=3 \times 10^8$ মিঃ /ছেঃ), h ($=6.626 \times 10^{-34}$ জুল ছেঃ), k_B ($= 1.38 \times 10^{-23}$ জুল কেলভিন$^{-1}$) আদিৰ বিভিন্ন সাংখ্যিক মানবোৰতেই নিহিত হৈ আছে মহাবিশ্বৰ গুপুত ৰহস্য। গণিতত 'ফলন' (function) বুলি এটা ধাৰণা আছে। এই 'ফলন' (function)ৰ ধাৰণাৰ ওপৰতেই সমগ্ৰ 'কোৱান্টাম বলবিদ্যা' (Quantum Mechanics) বিদ্যমান। অৱশ্যে ই এক বিশেষ ধৰণৰ ফলন, যথা 'তৰংগ ফলন' (Wave Function)। ই স্থান আৰু কালত কথিকা এটাৰ সম্ভাব্য অৱস্থিতি সূচায়। এই 'Quantum Mechanics'ৰ মতেই

আমাৰ বিশ্বব্ৰহ্মাণ্ডৰ দৰে আৰু অসংখ্য বিশ্বব্ৰহ্মাণ্ড আছে। যাক কোৱা হয়, 'Parallel Universe' (সমান্তৰীয় বিশ্বব্ৰহ্মাণ্ড) বুলি। গাণিতিক ভাৱে ই প্ৰমাণিত হৈছে, হোৱা নাই কেৱল পৰীক্ষামূলক ভাৱেহে। ই সঁচাকৈয়ে এক ৰোমাঞ্চকৰ ধাৰণা। এনেধৰণৰ আৰু বহু কথা আছে, যিয়ে পদাৰ্থ বিজ্ঞানক এক অনন্য বিস্তৃতি তথা মাত্ৰা দিছে আৰু ই সম্ভৱ হৈছে কেৱল গণিতৰ বাবেহে। গণিতেহে পদাৰ্থ বিজ্ঞানক এক অপূৰ্ব মাত্ৰা দিছে অন্যথা ই এক নীৰস বিষয়ৰূপে এচুকত পৰি ৰ'লহেঁতেন। প্ৰকৃতিৰ প্ৰায় আটাইবোৰ নিয়মকে গণিতৰ মাধ্যমেৰে উপলব্ধি কৰাৰ যি প্ৰয়াস, সি সঁচাকৈয়ে এক বিস্ময় তথা অতুলনীয়। ইয়েই আমাক ধূলিকণাতকৈও অতি নগণ্য অস্তিত্বৰ গৰাকী হোৱাৰ পিছতো এক সাৰ্বজনীন আৰু সৰ্বকালীন পৰিচয় দিয়ে। ইয়েই আমাক এই মহাবিশ্বৰ লগত বাৰ্তালাপৰ সুযোগ আৰু সুবিধা দিয়ে। কাৰণ, গেলিলিওৱে কোৱাৰ দৰে, এই প্ৰকৃতিৰ ভাষা হ'ল গণিত। এই প্ৰকৃতিকে আমি অধ্যয়ন কৰোঁ পদাৰ্থ বিজ্ঞানৰ জখলা বগাই। গতিকে সেই বিজ্ঞানৰ ৰাণী 'গণিত' নহৈ পাৰেনে? অৰ্থাৎ 'গণিত', সাৰ্বজনীন-সৰ্বকালীন।। সৰ্বশেষত ৰামানুজনৰ এটি বিখ্যাত উক্তিৰে এই লিখনিৰ অন্ত পেলাব বিচাৰিছোঁ - "An equation means nothing to me unless it expresses a thought of God." – Ramanujan. ■

- A perfect number is a number that is equal to the sum of its proper divisors (excluding the number itself). The first four perfect numbers are 6, 28, 496, and 8128.
- The longest word in the English language that contains only letters used in the first 10 digits of the decimal system (0-9) is "uncopyrightable".

Mathematics for a Better Life

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6th Sem., Department of Mathematics

Teachers of my school days have always been saying that "Math is everywhere", without elaborating on the true meaning of it. I've always been thinking about the utility of mathematics in our daily lives. Those thoughts like "is there any use of Sinx or int(2x) ", which probably most of us think about once in a while. Though we were made aware Mathematics is a very broad concept and functional and has been a part of humankind forever, but failed to realize how intriguing it is. It was only later I learned the actual role of math and how it has been helping us out. It's no longer just the language of science, mathematics now contributes in direct and fundamental ways to business, finance, health, and defense. For students, it opens doors to careers. For citizens, it enables informed decisions. For nations, it provides knowledge to compete in a technological community.

Leopold Kronecker once stated that "The natural numbers come from God, everything else is man's work". We, humans, have an undying curiosity about everything and we try to develop solutions to unanswered questions. There is such a huge correlation that ties the cosmic perspectives and mathematics. If it weren't for maths, we would've been left out of knowing so much about the universe. Starting from the knowledge of orbits of different planets that have led to the discovery of other planets like Neptune, to The Big Bang Theory, maths has played a crucial role in discovering various mysteries of the universe. Black Hole, which is still a riddle, could be easily explained by simple algebra and pre-algebraic skills. This tells us a lot about how maths could be helpful in future discoveries in cosmic studies.

Architecture and design rely heavily on mathematics. Therefore, any architect, or civil engineer should know the theoretical foundations of mathematics, be able to build mathematical models, and solve problems, using methods of mathematical statistics to process experimental data. That is why any person deciding to pursue a career in this field must have a well-developed mathematical concept. Mathematics is used in nearly every aspect of home building, be it to calculate the volume of concrete required to pour the foundation or the number of bricks necessary for the exterior walls or calculate the angle of cuts to make a proper roof slope or to calculate the ceiling dimensions. Just about every aspect of our life can be broken down into mathematical expressions. Not only in architecture, but maths has also influenced technologies. Mathematics is the tool that has been used to develop scientific principles and discoveries in industrial production. In the past, any findings in the laboratory had to undergo pilot testing. Nowadays, this is replaced by mathematical simulation, saving time and cost. We may not be aware that mathematics has been used with practically everything associated with technology or technological decision. One of the few areas where Einstein's theory of relativity directly impacts our lives is the latest navigation system, GPS. Maths has played a very vital role in making navigation as accurate as it is today and it was one of the best inventions in modern technologies that made our lives so much easier. Another even more spectacular invention was the computer which changed our lives dramatically. They are now being used in all walks of life; health, education, communication, engineering, crime detection, navigation, and many other fields. Computing involves a particular branch of mathematics - Discrete Mathematics. Notations and concepts of discrete mathematics are used to study problems in algorithms and programming. In times like COVID-19, these technologies helped a lot in tough decision making and even in further future, they will continue to do so.

These tough times are often accompanied by economical imbalances. One must maintain a responsible budget so that one can meet theirs needs without overspending. Not only in times like this but general finance management is important for proper living. Mathematics affects the financial decisions that we make every day. From paying our bills to using coupons at the grocery store, math is a part of our everyday lives. Number sense and a facility with mathematical concepts are especially useful in banking. We use math for budgeting, spending, saving, and investing. In each case, a good understanding of mathematical concepts will be beneficial for your finances. From the most basic concepts of budgeting and spending to the more complex concepts of investments and interest, math is used everywhere concerning banking. We live in a world where one must have a strong sense of mathematical principles to manage finances.

Mathematics is helpful not only economically or scientifically but also helps analyze situations. Statistics keep us informed about, what is happening in the world around us. Statistics are important because today we live in the information world and much of this information is determined mathematically with the help of statistics. Everybody watches weather forecasting. Have you ever thought about how you get that information? There are some computer models built on statistical concepts. These computer models compare prior weather with the current weather and predict future weather. Doctors predict disease based on statistics concepts. Suppose a survey shows that 75%-80% of people having COVID show specific symptoms

like fever and headache. When statistics are involved, then you can have a better idea of how the virus may affect your body or understand what the actual cause of spreading infection could be. Statistics data allow us to collect information around the world. The internet is a device that helps us to collect information. The fundamentals behind the internet are based on statistics and mathematics concepts.

Whether realizing it or not, mathematics has probably influenced everything around us. Technology is all based on mathematics. Electronic circuits can be defined as mathematical functions. Battery life can be described using a mathematical equation. even if you don't count yourself a fan of mathematics, it's hard to argue that it hasn't been a crucial factor in our rapid evolution as a society. We reached the moon because of math. Math allowed us to create and transmit electricity over hundreds of miles to power our homes, and gave rise to computers. Without math, we'd probably still be living in caves.

As Einstein truly said- " What is mathematics? It is only a systematic effort of solving puzzles posed by nature." And we have yet to learn so much. ■

> As far as the laws of mathematics refer to reality, they are not certain and as far as they are certain, they can not refer to reality.
>
> **– Albert Einstein**

Women in Mathematics

Bhabana Sharma
2nd Sem., Department of Mathematics

"We can all do our part to unleash our world's enormous untapped talent- starting with filling classrooms, laboratories, and boardrooms with women."

-UN General Secretary, Antonio Guterres.

Women and girls represent half the population and, therefore, also half of it's potential. Gender equality has been a controversial affair in recent times. A significant gender gap has persisted throughout the years at all levels of science and math. Even though women have fought tooth and nail towards increasing their participation inadvanced education, they are still under-appreciated in our field.

Analyzing various studies over a period of time, it's been found that the under-representation of women in mathematics are results of deep-rooted social stigma, discrimination, gender biases, and lack of role models that greatly influence the quality of education and hamper their capabilities. The field of mathematics has remained a male dominated sector for centuries. Time and time again we hear and study names and theories of great men and their contributions towards our field. Come to think about it, had women been given the same opportunities to educate themselves, had had less societal pressure towards marriage and children; we probably would've been flooded with brilliant women who revolutionized the field!

In the 21st century, the scene has changed for the better to a great extent and there seems to be light peeping at the end of the tunnel. In the past few years, women have been exposed to excellent opportunities to dip their feet in the field of mathematical sciences.

Often, we gravitate towards role models that seem to be like us, it seems that if someone like us can achieve their dreams, we can too. I am extremely lucky to be under the guidance of such role models, women who have defeated all norms and have established themselves at great heights in the mathematical field. Being in a department fueled 85% by women has encouraged us, young women, to pursue and thrive in mathematics. Yes, women form the core of the department of mathematical sciences at our institution. These women of utmost intelligence, courage and determination have paved a path for future generations of women who have the zeal to enter into this oh-so challenging and exciting field.

Strong mathematical base creates critical thinkers, problem solvers, and next generation innovators. The field is well into its extraordinary era with the participation of women in mathematics! ■

গণিত: এক আৱেগ

জিতুলময় নাথ
দ্বিতীয় ষান্মাসিক, গণিত বিভাগ

নক'লেও হ'ব যে গণিত অবিহনে মানুহৰ জীৱন অৰ্থহীন। সৰুতে গণিতৰ ধাৰণা আজিৰ দৰে নাছিল। গণিত বুলি ক'লে কেৱল সংখ্যা আৰু তাৰ লগত জড়িত যোগ, বিয়োগ, পূৰণ, হৰণ এয়াই আছিল যেন লাগিছিল। কিন্তু সময়ৰ টিকনি আগবঢ়াৰ লগে লগে মনত বাহ লোৱা গণিতৰ ধাৰণাও যেন ক্ৰমাৎ পৰিবৰ্তন হ'বলৈ ধৰিলে। অৱশ্যে ছাত্ৰ কুমলীয়া বয়সত পোৱা সংখ্যাৰ খেল/যাদুবোবো যথেষ্ট আকৰ্ষণীয় আছিল আমাৰ বাবে, যথা..

1) 1, 2, 3, 4, 5, 6, 7, 8 আৰু 9 ব্যৱহাৰ কৰি পাব পাৰিনে?

$$\frac{148}{296}+\frac{35}{70}=1$$

2) ঘূৰ্ণীয়মান সংখ্যা: 142857 এই সংখ্যাটোক 1, 2, 3, 4, 5 আৰু 6 ৰে পূৰণ কৰিলে সংখ্যাটোত থকা অংকৰে গঠিত অন্য এটা সংখ্যা পোৱা যাব।

$142857\times1=142857$

$142857\times2=285714$

$142857\times3=428571$

....

$142857\times6=857142$

আকৌ $142857\times7 = 999999$ (Interesting..)

3) 1729 সংখ্যাটো মনত আছেনে, যাক ৰামানুজন সংখ্যা বুলি কোৱা হয়। ই এনেকুৱা এটা সংখ্যা যাক দুটা সংখ্যাৰ ঘনকৰ যোগফল হিচাপে দুই ধৰণে প্ৰকাশ কৰিব পৰা আটাইতকৈ সৰু সংখ্যা।

i.e., $1^3 + 12^3 = 9^3 + 10^3$

এইবোৰ সঁচাই আকৰ্ষণীয়। আপোনাৰ কাৰণেও এইবোৰ আকৰ্ষণীয় আছিলেনে?

এইবোৰ সংখ্যা -গণিতৰ যাদুয়ে আমাৰ মনত গণিতৰ প্ৰতি যি কেৱল ভালপোৱাই আনি দিছিল এনে নহয়, গণিতৰ প্ৰতি নতুন নতুন ধাৰণা বা প্ৰশ্নৰ আবিৰ্ভাৱ ঘটাইছিল। পৰবৰ্তী সময়ত গণিতৰ নতুন নতুন সংযোজনে

নতুন নতুন ধৰণা শিকাই গ'ল। পৰিমাণ (Quantity), গঠন (Structure), পৰিৱৰ্তন (Change), স্থান (Space), বিষয়ক গৱেষণাকে গণিত বোলা হয় বুলি গম পালো। অৱশ্যে অন্য কিছুমানৰ মতে গণিত হ'ল চিত্ৰ (Figure) আৰু সংখ্যাৰ ওপৰত গৱেষণা; কিন্তু এয়া হ'ল গণিতৰ অতি সৰল সংজ্ঞা।

বিধিগত দৃষ্টিকোণৰ পৰা চালে, গণিত হ'ল যুক্তিবিজ্ঞান (Logic), বিশেষ প্ৰতীকী- চিহ্নাদি (Notation), ব্যৱহাৰ কৰি স্বত:সিদ্ধ ৰূপে সংজ্ঞায়িত বিমূৰ্ত গঠন সমূহৰ (Axiomatically defined Abstract structures) গৱেষণা, অৰ্থাৎ গণিত হ'ল বিভিন্ন ধৰণৰ বিমূৰ্ত মানসিক খেল আৰু গণিতৰ কাম হ'ল এই বিমূৰ্ত মানসিক খেলসমূহৰ মাজত সম্পৰ্ক স্থাপন কৰা।

প্ৰকৃততে যেনেকৈ গণিতৰ প্ৰকৃত সংজ্ঞা দিয়াটো কঠিন তেনেকৈ গণিতৰ পৰিসৰও অতি বহল। গণিত অধ্যয়নে আমাক শিকায় Logically চিন্তা-চৰ্চা কৰিবলৈ, Accurate Result এটাত উপনীত হ'বলৈ আৰু সেয়াও অতি কম সময়ৰ ব্যৱধানত। এনেবোৰ কাৰণতে সমাজ জীৱনৰ সকলোবোৰ বিষয় বস্তুৱেই গণিতক লগত লৈহে আগুৱাই যাব পাৰিছে। হয়তো সেইকাৰণে কোৱা হয় বিজ্ঞানৰ সকলোবোৰ শাখাতে গণিতৰ ব্যৱহাৰ আছে। গণিতক সেয়ে 'বিজ্ঞানৰ ভাষা', 'বিশ্বৰ ভাষা' তথা 'সমস্ত বিজ্ঞানৰ ৰাণী' বুলি কোৱা হয়।

সেয়ে হয়তো কোৱা হয় যে গণিতৰ আবেগ যেন চিৰস্মৰণীয়, অভূতপূৰ্ব। ■

Breakthrough Prize

The Breakthrough prize, renowned as the 'Oscars of Science', recognizes the world's top scientists in the fundamental sciences. It is conferred in three categories-Mathematics, Fundamental Physics and Life Sciences. Awardees receive 3 million USD each in prize money, which is higher than 1 million USD received by Nobel Laureates.

Maryna Viazovska: Winner of Fields Medal, 2022

Nijara Konch
Assistant Professor
Department of Mathematics

Maryna Viazovska, the Chair of Number Theory and full Professor at the École Polytechnique Fédérale de Lausanne (EPCL), Switzerland is one of the awardee of Fields Medal, 2022. She is the second woman to receive this prestigious award which is considered as Nobel Prize in Mathematics after Iran's Maryam Mirzakhani in 2014. The other three laureates for the year 2022 was France's Hugo Duminil, June Huh from Princeton University and Britain's James Maynard.

Viazovska was born on 2nd Dec, 1984 in Kyiv, the capital city of Ukraine (in then Soviet Union) which was invaded by Russia in February 2022. So in the time of bloodshed for a small country like Ukraine, this honour brings tremendous glory to her motherland which is even facing existential crisis.

Fields medal is bestowed to the mathematicians below the age of 40 (at the time of awarding it) in every four years since 1936 at the event of International Congress of Mathematicians. This medal is awarded to recognize and honour the outstanding contribution to the field of mathematics. Other significant awards received by Maryna Viazovska includes Salem prize (2016), SASTRA Ramanujan proze (2017), European prize in Combinatorics (2017) and Fermat's prize (2019) etc..

Viazovska was very brilliant from her early days and attended school designed specially for high achieving students in science and technology at Kyiv. She topped in International Mathematics Competition for University Student's in 2002 and 2005. She did her master's degree from University of Kaiserslautern, Germany in 2007 and received her Indian equivalent doctor of philosophy (which is the first of two doctoral level scientific degree in Russia and in Commonwealth States) from Institute of Mathematics of the National Academy of Sciences, Ukraine in 2010. Then received second and final doctoral degree Doctor Rerum Naturalism

(Dr. rer. nat. in brief) called Doctor of Natural Sciences from University of Bonn, Germany in 2013. Her doctoral thesis entitled "Modular Functions and Special Cycles" related to 'analytical number theory' and guided by Don Zagier and Werner Müller.

She works on numbers, geometric shapes, their intermediate connections and geometric optimization problems mainly sphere packing. Sphere packing is a very natural geometric problem in which putting infinitely many spheres or balls (usually of uniform size) are discussed within a certain volume say big box (usually in a 3-dimentional Euclidean Space). Legend is that people were interested in how many cannon balls can they pack into a ship! The answer for the cannon ball is that they must be stocked in pyramidal shape like oranges are packed in a supermarket. This is the best possible packing for this. But mathematicians always think beyond; they are always curious about new things, new dimensions. Nothing stops them from adding one coordinate or 24 different coordinates. Over the years mathematicians are trying to solve this sphere packing problem of different dimensions by discovering different techniques and optimality conditions and have found bounds that shows nothing better can be done. Among them Johannes Kepler (made Kepler conjecture), John Leech (Discovered Leech Lattice), John Conway (studied symmetry of Leech Lattice), Thomas Hales (Proved Kepler conjecture), Henry Cohn and Noam Elkies (developed the method of magic functions) etc. offered significant contribution in this regard. However, it is found that, in dimension 8 and 24, the bound came very very close to the actual density of known packings. In dimension 8, this bound is close to E_8 packing and in dimension 24, it is close to Leech Lattice. Hence mathematicians realized that there must exists some function which is supposed to describe this optimality of packing. Finally in 2016, Maryna Viazovska has given an explicit formula for the magic function after the 13 years of continuous and rigorous research. In 2016, when Viazovska solved the sphere packing problem in dimension 8, very quickly it led to the solution in dimension 24 in collaboration with others. When the proof for Kepler conjecture involves long computer calculation, in contrast, Viazovska's proof for 8 and 24 dimension looked 'stunningly simple'. Besides this, she is also engaged in significant research on spherical designs which includes existence of small things in arbitrary dimensions. In Dec 2022, she was also honoured as one of the BBC 100 women around the world. She is married to Professor Daniil, who is also a physicist at EPFL. Against the stereotype thinking that women are weak in mathematics, she is a befitting reply to that. In coming days world is excited to see the great mathematical discoveries by this young and dynamic lady. ■

Factorial Zero

0!

Abhishek Goswami
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Dept. of Mathematics

Mathematics - an incredible tale of numbers full of thrilling combinations, engrossing ideas, and musing questions. I believe mathematics is gripping because it reveals its cardswhen they are least expected. A few days back, I came to know the story of 0!. This may not sound very tempting to mathematics wizards reading this but believe me, I was totally in love with mathematics once again with this simple yet not so simple question. So this exclamation looking symbol is a Mathematical operation factorial which means to multiply a series of descending natural numbers. For example 4! =4*3*2*1=24. Now we take it as a fact that 0!=1, but what's funny is that how can we decrease a number till 1 which is already less than 1. So to decode this cipher, let us all do a mental exercise. So let's calculate what is 5!, 4!, 3!, 2!, 1! So

5!=5*4*3*2*1=120

5!=5*4*3*2*1=120

4!=4*3*2*1=24

3!=3*2*1=6

2!=2*1=2

1!=1

and now if we look closely 4! is nothing but 5!/5 and 3! is 4!/4. Going on 2! = 3!/3 and 1! = 2!/2 and leaping one step forward we can get 0! That is 1! /1 and yes it results in 1. Isn't it baffling that multiplying no numbers together results in 1? This is how mathematics is beautiful. ■

Can Computers be Mathematicians?

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Artificial Intelligence has already bested humans at problem-solving tasks that include games like chess and Go, which is a compiled high-level programming language. But before any task can be tackled by a machine, it must be reinterpreted as directions in a language that a computers can understand. We have probably heard about an IBM computer called Deep Blue, which managed to beat the best human chess player in the world, Garry Kasparov, back in 1997. Deep Blue, of course, being a computer, was very fast. It could evaluate 200 million chess positions a second. And it based its evaluations of those positions on a gigantic library of chess knowledge that its programmers had built into it. And there has been assumption that in some maybe-distant future, there will be a time when the descendants of Lean will be able to take over humans.

For the last few years, researchers and amateurs all over the world have worked together to translate the essentials axioms of mathematics into a programming language called Lean. Armed with this knowledge of algebra, geometry and logic, these programs, known as proof assistants, do the busy work for people, checking their work vigorously. This frees up time and mental space for mathematicians to be more creative. Theorem proving programs that understand Lean have begun helping some of the world's greatest mathematicians verify their work of accuracy of a complicated proof. So the question is, what can computers do for pure mathematics, now and in the coming years?

Theorem-provers have been around since the 1960's,1970's. Lean has the edge over some of the other theorem-provers, because we can write, it means that it's taken the things we've told it, and it's translated those things down to the bare-bones axioms of mathematics and checked that everything checks out. And to get from that kind of sketch proof down to the axioms, one has to have something running in the background that's trying to interpret what's going on and translating it all down into the bare-bones axioms of mathematics. So these are called tactics. It makes it more comfortable for people who aren't necessarily Ph.D.s in computer science, or even computer kind of people, to just speak in the natural language that mathematicians are comfortable with. And yet somehow, it can then translate. For example-

we want to check that (x+y), all squared, is $x^2 + 2xy + y^2$. We want to expand out the brackets. If we try doing that from the axioms of mathematics, then that takes about 20 lines. So tactics are these higher-powered arguments that one can use to make it more like we're communicating with a smart undergraduate rather than a rigid machine that can do nothing other than the basic steps in logic.

It seems that mathematicians are teaching math to Lean, and Lean is doing what it does so well, checking the logical steps to verify that the proof strategies that have been outlined really can be made to work, all the way down to the axiom level. So if we teach a computer, all the known tools in one of those areas, and then say, now go ahead, start putting them together in a billion different ways and see which ways are productive, we can imagine that maybe computers would have more success. But, for example, in a field of number theory, there may have a big disadvantage when it comes to proving theorems. And it may took many, many years for the ideas to crystallize into the notion of a modular form and that's the artistic part of mathematics, whereas, Lean does the scientific part very well, everything is rigorously defined, and there are very clear rules and one follows the science and one proves the theorem. But creating the notion of an elliptic curve, or, the idea of a Galois representation, these are the things that have very much formed by humans. So, if computers can't have those insights we aren't yet convinced that they can have those insights at the required levels. And so, thus, there would be big drawback when it comes to proving theorems. ■

Chern Medal

One of the newer prizes in mathematics is the Chern Madel which was first awarded in 2010. It is an international award recognizing outstanding lifelong achievement of the highest level in the field of mathematics which includes a cash prize of US $ 2,50,000. The prize is given at the International Congress of Mathematicians (ICM) which helds in every four years.

নাশ্ব সাম্যাৱস্থা

কংকন ঠাকুৰীয়া
দ্বিতীয় যাণ্মাসিক, গণিত বিভাগ

যদিও খেল সূত্ৰৰ লগত জড়িত নাশ্ব সাম্যাৱস্থাক একাডেমী এৱাৰ্ড বিজয়ী "A Beautiful Mind" নামৰ কথাছবিখনত প্ৰাধান্য দিয়া হৈছিল; কথাছবি এখনৰ বাবে সম্পূৰ্ণ ধাৰণাটো দাঙি ধৰাটো নিশ্চয় সম্ভৱ নাছিল। চলচ্চিত্ৰখনত যিজন গণিতজ্ঞৰ আবেগিক যাত্ৰাক উপস্থাপন কৰা হৈছিল তেওঁই আছিল নাশ্ব সাম্যাৱস্থাৰ আৱিষ্কাৰক — **জন ফৰ্বছ নাশ্ব।**

নাশ্ব সাম্যাৱস্থা অসহযোগিতামূলক খেলৰ ক্ষেত্ৰত প্ৰযোজ্য। এনে খেল বা বাস্তৱ জীৱনৰ দৃশ্যপটত একে লক্ষ্য থকা দুটা প্ৰতিযোগী পক্ষই কিছুমান এনে সিদ্ধান্ত ল'বলগীয়া হয় যিবোৰ বিৰোধী পক্ষৰ হ'ব পৰা সিদ্ধান্তৰ ওপৰত নিৰ্ভৰ কৰে। উদাহৰণস্বৰূপে, এটা এনে ব্যৱস্থা কল্পনা কৰা হ'ল য'ত এটা ঠেক পথত দুখন গাড়ী দুটা বিপৰীত দিশেৰে আহি আছে। দুয়োখন গাড়ীৰ সংঘৰ্ষ নোহোৱাকৈ পাৰ হোৱাৰ কোনো সম্ভাৱনা নাই, যেতিয়ালৈকে দুয়োখন গাড়ীয়ে নিজৰ নিজৰ দৃষ্টিকোণৰ পৰা বাওঁফালে পথৰ দাঁতিয়েদি যোৱাৰ সিদ্ধান্ত নলয় । এয়া হ'ল এটা নাশ্ব সাম্যাৱস্থা য'ত এনে এটা দ্বৈত সিদ্ধান্ত আছে যিটো দুয়োপক্ষই মানিলেহে দুয়োপক্ষ সফল হ'ব। যদি কোনোবা এটা পক্ষইও এই সিদ্ধান্তক আওঁকাণ কৰে তেতিয়া দুয়োপক্ষই বিফল হ'ব।

এই ধাৰণা কিছু জটিল ব্যৱস্থাত প্ৰয়োগৰ পৰা জানিব পৰা যায় যে বহুতো ব্যৱস্থাত প্ৰতিযোগীসকলক সকোলোৰে বাবে আদৰ্শ কৌশলৰ কথা জনোৱাটো সামূহিক জয়ৰ কাৰণে বেছি কাৰ্যকৰী। আকৌ আগৰ উদাহৰণটোলৈ ঘূৰি যাওঁ। এইবাৰ ৰাস্তাটো আগতকৈ কিছু বহল। এতিয়া কোনোবা এখন গাড়ীয়ে কাষেৰে গ'লে আনখনে নিজৰ পথ সলনি নকৰিলেও খুন্দা নলগাকৈ পাৰ হৈ যাব পাৰিব। ইয়াক খেল সূত্ৰত মিশ্ৰিত কৌশল বুলি কোৱা হয়। ইয়াত যদিও নিজৰ পথত থকা গাড়ীখনে কিছু সময় বচোৱাত সক্ষম হ'ব কিন্তু এইক্ষেত্ৰত সফল ফলাফলৰ সম্ভাৱনা কম। কিয়নো ইয়াত দুয়োখন গাড়ীয়ে কাষেৰে নগৈ নিজ পথত থকাৰ সিদ্ধান্ত লোৱাৰো সম্ভাৱনা নাথাকিব। ইয়াৰ সমাধানৰ বাবে দুয়োখন গাড়ীৰ চালকক এই দায়িত্বৰ কথা অৱগত কৰাব লাগিব যে তেওঁলোক দুয়োজনেই নিজৰ নিজৰ গাড়ী কাষেৰে লৈ গ'লেহে দুৰ্ঘটনাৰ পৰা বাচিব পাৰিব।

প্ৰথম চাওঁনিত এয়া নিচেই সাধাৰণ জ্ঞানৰ কথা যেন লাগে। কিন্তু এনে এটা সময় আছিল যেতিয়া চৰকাৰে উপলব্ধি কৰা নছিল যে ট্ৰেফিক ব্যৱস্থা আৰু চালকৰ শিক্ষা জনসুৰক্ষাৰ বাবে অতি আৱশ্যক। এতিয়াৰ ট্ৰেফিক ব্যৱস্থাতো নাশ্ব সাম্যাৱস্থাৰ প্ৰয়োগ দেখা যায়। এটা দিশত গাড়ীবোৰ ঠিক মতে চলি থাকিবৰ বাবে আন দিশৰ গাড়ীবোৰ ৰখাটো খুবেই জৰুৰী। সামৰিক জগততো নাশ্ব সাম্যাৱস্থা খাটে। এই ব্যৱস্থাত সকলো দেশেই আন দেশৰ হাতত থকা ধ্বংসকাৰী অস্ত্ৰৰ তথ্য লাভ কৰাটো জৰুৰী। দুখন গাড়ীয়ে যেতিয়া নিজৰ আদৰ্শ ভূমিকা নোলোৱাৰ ফলত হ'ব লগা দুৰ্ঘটনাৰ কথা গম পায় তেতিয়া দুয়োখনে নিজৰ আচৰণত শুধৰণি কৰে। ঠিক তেনেদৰে পাৰমাণৱিক শক্তিৰ ব্যৱহাৰৰ ফলত সাম্যাৱস্থাত আৰম্ভ হ'ব পৰা অস্থিৰতাৰ বিষয়ে জ্ঞাত হোৱাৰ ফলত দেশবোৰে আণৱিক অস্ত্ৰ ব্যৱহাৰৰ পৰা বিৰত থাকে। ■

Mathematics for a better World

Richa Kalita
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Mathematics is the study of quantity, structures, shapes and space which help us seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from approximately chosen axims and definitions.

Mathematics can be enormously interesting and inspiring, but its beauty and utility are often hidden Most people tend to run away from the mere mention of the word math. They don't even know that they think mathematically all the time. We all use simple arithmetic every day when we buy groceries, a newspaper or a movie ticket. We also do more high level mathematical reasoning all the time, unaware of the complexity of our thinking.

Math now reaches into every corner of our lives. Electronic devices like smartphones and iPods, which we use daily, depend on the application of maths, as do computers, communication systems and the internet. Operation of air traffic control requires implementation of mathematical tools too. International trade and the financial markets rely critically on secure communication, using encryption methods, that spring directly, from number theory, one thought to be a field of pure mathematics without 'useful' applications.

Most hill walkers can recall an axious time when, caught on a ridge between steep slopes, enshrouded by dense fog. The immediate question is "Where exactly am I?" Maps and compass are vital aids, but they canot answer that question. A small hand held device based on GPS can.

The GPS (Global Positioning System) is a satellite based navigation system. To compute
the position, the GPS receiver uses signals from several satellites, each including the precise
time and location of the satellite. The satellites are synchronised so that the signals are transmitted
at precisely the same instant. But they arrive at the GPS receiver at slightly different times
using the known signal speed, the speed of light, the distance to each satellite is determined.
These distances are then used to calculate the position of the receiver, using trilateration.
These distances are then used to calculate the position of the receiver, using trilateration.

GPS is one of those technologies that has crept up on everyone and entwined itself with
other useful technologies to become invaluable in our ever growing world, all thanks to math.

Mathematics also plays an important role in crime investigations helping scientist to
work out a range of problems including fingerprint recognition, DNA profiles and bullet
trajectories, that an understanding of the subject could be a key for the next great detective.
Application of mathematics along with other technological innovations in the field of criminal

investigation, has enabled today's forensic investigators, to remain a step ahead of the criminals, delivering justice, making the world a better place to live in.

Once upon a time biology meant zoology and botany, the study of animals and plants. But now it has been transformed from a descriptive science to a quantitative discipline.

Biological systems are hugely complex, but mathematical models which uses concepts such as network analysis, group theory, differential equation, probability, chaos theory and combinatorics aid in solving those tough problems in the life sciences.

Many lives are saved each year through a synergistic combination of engineering physics, medical science and mathematics. This combination is CT (Computed Tomography) imaging technology. Radiologists can use CT scans to examine all major parts of the body. In a CT scan, multiple X-ray images are taken from different directions. The X-ray data are then fed into a tomographic reconstruction program to be processed by a computer. The image construction problem is essentially a mathematical procedure.

Applications of tomography are not confined to medicine. The technique is also used in engineering and manufacture of microchips. It's also used to compute ozone concentration in the atmosphere from satellite data.

The communication networks in the human body involve millions of interlinked cells. Occasionally these networks break down, causing diseases. Systems Biology, another inter-disciplinary field of biological research uses mathematical models for designing new therapeutic approaches based on a system's mechanistic understanding of cellular networks. In the era of pandemics, epidemiological analysis and mathematical models are essential tools in understanding and responding to infectious diseases such as Covid-19.

Public health authorities are faced with crucial questions such as : How many do we need to vaccinate to prevent an epidemic? How should programmes be designed for prevention and control of outbreaks? The models built using concepts of mathematics such as dynamical systems theory, statistics, network theory and computational science, allow us to quantify mortality rates, levels of threat and timescale of epidemics. They can also predict the effectiveness of vaccination programmes and control policies such as travel restrictions.

Parameters like transmission rates and basic reproduction numbers cannot be accurately estimated for a new infection until an outbreak actually occurs. But models can be used to study 'what if' scenarios to estimate the likely consequences of future epidemics or pandemics. All models of epidemics have limitations and those using them must bear these in mind. Given the vagaries of human behaviour, prediction of the exact development of an infectious outbreak is never possible. Nevertheless models provide valuable insights not available through any other means.

It's high time we start appreciating mathematics because it has tremendously contributed for the betterment of the world in so many ways while being underrated all of the time. ■

Exploring Astronomy with Mathematics

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Astronomy is the study of celestial bodies and relating phenomena. Astronomy studies everything beyond earth's atmosphere. To explain the origin and evolution of planets, moons, stars, nebulae, galaxies, comets and many other celestialbodies, astronomy takes into consideration the various branches of mathematics, physics, chemistry,etc.

The night sky,with its charming beauty and mysteries, has always attracted the human civilization. The early civilizations including the Babylonians, Greeks, Indians, Egyptians, Chinese, Maya, etc. made methodical observations of the night sky.

Since ancient times, mathematics and astronomy are intertwined and inseparable. Both the branches go hand in hand. The phenomena or observations which cannot be reasoned or explained by the knowledge of physics can be explained through mathematics.

Astronomers have developed mathematical models with sufficient precision to explain the formation of celestial bodies, their future, origin and the very history of it possible. The discovery of the planet Neptune by mathematical computations and not by empirical experiments is an example of the same. In modern times, technology like string computers with specialized software by the use of mathematics have helped extremely in space missions of astronomers.

Mathematics allows astronomers to predict the movements of celestial bodies, calculate the distances and sizes and hence prepare mathematical models of the universe. The Babylonians were the ancient civilization to use complex mathematical calculations to predict ellipses and other events. They even developed a system of numeration based on the number 60 which is used in modern days to measure time and angles.

It is with the help of mathematics that researches are going on to discover exoplanets (outside of our solar system). Astronomers analyze the light from stars and identify the tell-tale signs of planets. They can also predict the temperature and composition of the exoplanets through mathematics.

Some branches of mathematics commonly used in astronomy are: trigonometry, conics, differential and integral calculus, statistics and probability, algebra.

Trigonometry was the primary tool of mathematics used by ancient astronomers. The changes in the sky can be explained by trigonometry. Distance between two stars is measured by measuring the angle formed between them from the observer's sight of view. The Greek astronomer Hipparchus developed a system of trigonometry to calculate the distance of the moon from the earth. He also developed a technique to measure the brightness of stars which is still in use.

Conic sections defined by the Greek mathematicians highlight different types of curves like circle, ellipse, parabola and hyperbola.Johannes Kepler formulated the Laws of Planetary Motions using conics, geometry and calculus to show that planets move in elliptical orbits around the sun and that they travel faster when they are closer to the sun. This led to the foundation of Newton's Laws of Motion.

It is by the idea of differential and integral calculus that Newton developed the laws of classical mechanics including the laws of motion and the universal law of gravitation. This in turn allowed him to explain the elliptical orbits of planets and the movement of comets.

Einstein formulated the famous Theory of Relativity whose mathematical framework is based on differential geometry, precisely Lorentzian varieties. Einstein was inclined towards Riemann's work and non-Euclidean geometry which led him to tensor calculus which is the primary language of the relativity theory.

To identify patterns in astronomical data, statistical tools are used to analyze data sets. Moreover, there is another tool called probability which is used to extract information from large samples of measurements. Statistics and probability are mainly used to understand the formation and evolution of planets and helps in search for extra-terrestrial life and exoplanets.

Furthermore, astronomers developed tools to study astronomical phenomena. Optical telescopes, radio telescopes, satellites etc. are used to collect astronomical data. Computers, mounts etc. improves the field of research of celestial bodies. All these advanced technologies are developed with the help of algebra. Use of a telescope requires complex calculations. For instance, it was while studying motion of objects that Galileo developed a telescope. The telescope's camera records a series of numbers by translating photons or electrons or protons. The sum of these numbers equals to the light produced by various celestial bodies which is further differentiated into types of light by using statistics and arithmetic.

So, we can conclude that all the laws governing the celestial bodies use mathematics to establish and test hypothesis. Hence, astronomy is growing more accurate with use of mathematics and creation of mathematical models and algorithms.

Mysteries of the cosmos are behind the science of mathematics, physics, chemistry. ■

Evolution of Mathematics with Time

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"GO DOWN DEEP INTO ANYTHING AND YOU WILL FIND MATHEMATICS"
– Dean Schlicter.

The history of mathematics is nearly as old as humanity itself. Since antiquity, mathematics has been fundamental to advances in science, engineering, and philosophy. It has evolved from simple counting, measurement and calculation, and the systematic study of the shapes and motions of physical objects, through the application of abstraction, imagination and logic, to the broad, complex and often abstract discipline we know today.

Mathematics has been an integral part of human history, and its evolution over the centuries has shaped our current understanding of the world. From the 16th to 19th century, mathematics underwent a series of changes that would eventually lead to the development of modern mathematics. During this period, mathematicians developed new concepts, theories and methods that laid the foundation for further advancements in mathematics. The Renaissance was an important period in this evolution, as it saw a shift from traditional mathematical methods to more abstract thinking. This shift allowed mathematicians to explore more challenging problems and develop new ideas that would shape our understanding of mathematics today. During this period, many famous mathematicians such as Isaac Newton, Gottfried Leibniz and Leonhard Euler made major contributions to mathematics. They developed theories such as calculus and probability theory which are still used in modern day mathematics. Furthermore, they also made advances in algebraic geometry which led to a better understanding of geometric shapes and figures. All these developments during this period paved the way.

The 16th to the 19th century was a time of tremendous advancement in the field of mathematics. It was a time of great mathematical discoveries and innovations that transformed the way people looked at and understood the world around them. In this essay, we will explore the evolution of mathematics from the 16th to the 19th century and how it shaped the way we understand mathematics today.

The 16th century was marked by the Renaissance, a period of great intellectual and cultural rebirth in Europe. During this time, mathematics was seen as an important tool for understanding the world, and many mathematicians focused on the study of geometry. One of the most notable mathematicians of the time was Gerolamo Cardano (1501-1576), who was a prolific writer on mathematics and science. He is credited with introducing the concept of complex numbers and was one of the first mathematicians to apply algebra to the study of geometry.

Another notable mathematician of the 16th century was John Napier (1550-1617), who is best known for his invention of logarithms. Logarithms allowed for complex calculations to be simplified, and they became an essential tool in fields such as astronomy and navigation.

The 17th century saw the rise of calculus, a branch of mathematics that deals with the study of continuous change. Two of the most important mathematicians of the time were Isaac Newton (1642-1727) and Gottfried Wilhelm Leibniz (1646-1716), who are credited with independently inventing calculus. Newton's work on calculus was closely tied to his laws of motion and theory of gravity, which revolutionized the field of physics.

Another important mathematician of the 17th century was Pierre de Fermat (1601-1665), who is best known for his work on number theory. Fermat's Last Theorem, which he conjectured but did not prove, was eventually solved by Andrew Wiles in the 20th century.

The 18th century was a time of great progress in the field of mathematics. Leonhard Euler (1707-1783) was one of the most important mathematicians of the time, and he made significant contributions to a wide range of fields, including calculus, number theory, and graph theory. He is credited with introducing the concept of the mathematical function and was one of the first mathematicians to use the symbol ? to represent the ratio of a circle's circumference to its diameter.

Another notable mathematician of the 18th century was Joseph-Louis Lagrange (1736-1813), who made important contributions to the study of mechanics and mathematical analysis. He is also credited with introducing the concept of the Lagrangian, which is a mathematical function used to describe the dynamics of a system.

The 19th century saw the development of new branches of mathematics, including topology and abstract algebra. One of the most important mathematicians of the time was Carl Friedrich Gauss (1777-1855), who made significant contributions to a wide range of fields, including number theory, statistics, and geometry. He is credited with introducing the concept of modular arithmetic and was one of the first mathematicians to study non-Euclidean geometry.

Another important mathematician of the 19th century was Bernhard Riemann (1826-1866), who made significant contributions to the study of analysis, number theory, and geometry. His work on the Riemann hypothesis, which concerns the distribution of prime numbers, remains one of the most important unsolved problems in mathematics today.

In conclusion, the evolution of mathematics from the 16th to the 19th century was marked by significant advancements and innovations that transformed the way we understand mathematics today. ■

My Personal Experience with Mathematics

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4th Sem., Department of Mathematics

Mathematics is a universal language that can become very confusing as the content continues to stretch itself with more advancement in skills. Difficulty occurs in many ways in Mathematics, just like in life, but it certainly depends on the learner, whether it is a struggle to overcome or an opportunity to learn.Math is an analytical concept and we often misread it just as a mere academic subject. Whereas, its versatility lies far beyond our imagination.

One who copes with the concepts of Mathematics, not only learns about various logics, methods and greater concepts but a life lesson always come along with it. The person develop skills like critical thinking, problem solving, reasoning, observation, estimation, organization and most important of all communication.

With the emergence of generation like ours, where mental deprivement has taken a huge toll over the people, solving a problem of mathematics can bring about development and improvement in the intellectual skills, which has been proven as a solution to overcome a lot severe mental sicknesses.

As a teenager, I have always been an over thinker and a mood spoiler of my own but with the skills I developed as a Mathematics student has helped me to overcome the distractions and amusement of this age and direct my mind and conscience to something more productive. Life, is never easy, and it is not always about the struggle and the success, rather it is more about the process of building throughout. And here, a concept like Mathematics generates the steps of that process of development and make life worth living. ■

SOME FUN FACTS ON MATHEMATICS

- Every odd number has 'E' in it.
- 'Four' is the only number that has same number of letters as the number itself.
- From zero to thousand , the only number which has letter A is 'THOUSAND'.
- FORTY is the only number that has letters arranged in alphabetical order.
- There is no symbol for Zero in roman numerals.

মাহুৰতা

জিতুলময় নাথ
দ্বিতীয় ষান্মাসিক, গণিত বিভাগ

মৌচুমী প্ৰবাহৰ আপুৰুগীয়া বতাহ
চৌদিশে বিয়পিছে শীতৰ প্ৰবাহ,
আকাশ, বতাহ, বায়ু, মাটি, পানী
সেমেকি উঠিছে,
নতুনত্বৰ প্ৰভাতক আদৰিবলৈ।
সেউজীৰ সুবাস
যেন বসন্তৰ আহ্বান
শুকান বতৰে পাইছে
জীৱনৰ নতুন প্ৰহ্লাদ।
সেয়ে মাহুৰতাই গাইছে জয়গান
বীৰত্বৰ বিৰাট।

মেলিছে পোখা, ফুলিছে কলি
চৌদিশে কেৱল প্ৰেমৰ বিৰিঙণি;
নঙলামুখৰ নিমজোপাই
নতুন সাজেৰে সাজি উঠিছে
মুক্ত বতাহেৰে কৰিবলৈ মুগ্ধ
জীৱন যৌৱন আৰু যশস্য মন।

বসন্তই আনিলে নতুন যুগ
চাৰিওফালে কেৱল কিৰিলি-বিদাৰি
নতুন প্ৰজন্মই মুক্ত পৰিৱেশত পোখা মেলিছে
লক্ষ্য যেন কেৱল!
সেয়ে মাহুৰতাই গাইছে জয়গান
বীৰত্বৰ বিৰাট। ■

3D Shapes

Nezam Uddin Ahmed
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3D shapes are fat not flat.
A cone is like a party hat.
A sphere is like a bouncy ball.
A prism is like a building tall.
A cylinder is like a can of pop.
A cube is like the dice you drop.
3D shapes are here and there.
3D shapes are everywhere ■

ৰাতি এটাৰ বাবে

চাহিদুল ইছলাম
চতুৰ্থ ষান্মাসিক, গণিত বিভাগ

গো-ধূলি উৰুৱাই নামি অহা
গধূলি এটাক গলধনত চেপি নামি আহে ৰাতি এটা

ৰাতি এটাৰ বাবে কবিতা লিখি দিয়াটো
ভবাতকৈ কঠিন

ৰাতি এটাৰ বুকুতো থাকে
কোনোৱেও নোগোৱা কিছু গান
কোনেও নুশুনা কিছু সুৰ
কোনেও নোকোৱা কিছু গল্প।

ৰাতি এটা বৈ যায় জিলিৰ মাতত
ৰাতি এটা বৈ যায় জোনাকীৰ পোহৰত
ৰাতি এটা বৈ যায় জোনত ডুলি থকা নাওঁখনত

ইচ্ছা কৰিলে ৰাতি এটাক নিজৰ কৰি ল'ব পাৰি
জিলিটোক প্ৰাণভৰি ভাল পাব পাৰি
ৰাতিটোক শুৱাই থ'ব পাৰি ঘড়ীৰ কাটাত
নাইবা শিয়ালৰ মাতত!

কালি ৰাতিটো আছিল অস্থিৰ
চৌকাৰ আগৰ জুইকুৰাৰ দৰে।
অসংখ্য চকুৱে আজুৰিছিল ৰাতিটোক!

কালি মৰা জোনৰ ৰাতি
ডুলি থকা নাওঁখন ডুবিছিল
নৱ বিবাহিত কাৰোবাৰ কুঠৰীত চঞ্চল হৈ উঠিছিল ৰাতিটো
চিগাৰেটৰ শেষৰটো হোপাত মোৰ আঙুলি পুৰিছিল!

কালি চোৱা এখন নাটকৰ শেষ দৃশ্যটোত
নায়কজনক চলনাৰে হত্যা কৰা হৈছিল।
কালি ৰাতি জুইত শেষৰটো চগা পুৰি মৰিছিল
গ্ৰন্থৰ উৎসৱত কালি ৰাতি
কবিৰঞ্জনক আকৌ হত্যা কৰিছিল

মাকৰ মুখৰ ভাষাটোৰ স্বাক্ষৰ দিবলৈ
এজন কবি কালি ৰাতি বুৰঞ্জীৰ পৰা উঠি অহা নাছিল!

কালি ৰাতিটো আছিল ক'লা ৰাতি
মৰা জোনৰ আন্ধাৰৰ ক'লা ৰাতি!

শেষ প্ৰান্ততঃ
কল্পনাৰো থাকে এখন কাল্পনিক সাগৰ
মুখাৰ ভিতৰতো থাকে একোখন মুখ
ৰাতিটো মৰিলেই সকলো অথন্তৰ!

ৰাতি এটাৰ কবিতা লিখাটো
সেয়ে সকলোৱে পক্ষে সহজ নহয়।
যিমান ভবা হয়। ■

Ocean of Emotions

Krishna Konwar
4th Sem., Department of Mathematics

One distant day,
I heard about a girl
She was an ocean of emotions...

Beautiful and charming
Kind and sweet
Entangled in thoughts
And more to it.

Dreaming in daylight
Lighting lamps at night
Holding others in problems
She's afraid of heights...

Heights of bond
Fear of separation
Diluted the sea
But wait she was an ocean...

Ocean of emotions
Love and care
You can drown in ocean,
It is fair...

Waves are the hugs,
You'll get one whenever you get closer
She is a girl with a smile
You can admire
No need to bother...
The ocean is real
The girl indeed...

Spare time
Let's dive into it... ■

> Mathematics reveals its secrets only to those who approach it with pure love, for its own beauty.
>
> **~ Archimedes**

How Human's are strong

Jashim Ahmed Talukdar
4th Sem., Department of Mathematics

I believe in the power of words
Many people speak before they think
But I know the value of words
Which can make you and break you as well
They can heal your soul
They can damage you all
So, I always try to use positive words in my life whenever I go.
It is okay to be scared, it is okay to cry
Everything is okay, but giving up is not be an option
They always say failure is not an option
Failure should be an option because
When we fail we get up and then you fail and
Then you get up and that's keep you going.
That's how humans are strong
Failure should be an option but giving up is not
I always say one thing that I have stopped
worrying about the things that I had lost
The people I had lost, things and people who
Were meant with one and are with me
Sometimes somebody's absence make you a better person.
Cherish their absence also. ■

Mathematics in Brief

Nezam Uddin Ahmed
4th Sem., Department of Mathematics

It starts with 'M'
Coordinate, I don't know why,
it doesn't even matter how hard I try.
I keep the formulas in my mind.
But it never comes out when it's time to write.
All I know,
that integration is a terrible thing
the answer never comes out,
when I try hard to think.
Probability comes out with all the cases,
pulls my breath away.
Its so unreal,
no matter how hard you try,
you'll never find the value of 'x' & 'y'.
Point of contact and the common chord,
waste your time and
watch it go…
Like numbers were not enough,
they introduced iota to make it even hard.
What it meant to be,
will eventually be a brainwreck of a kind.
GM tried so hard,
to pass AM once.
But in the end,
It doesn't even matter.
Limit tends to one,
expansions left undone.
But in the end,
It doesn't even matter. ■

A Thought

Krishna Konwar
4th Sem., Department of Mathematics

Dusk is admired more than dawn,
ever wondered why....???
Just because;
It really never matters how you start,
Beauty resides in how you end!! ■

The students of our department who have secured First Class in B.Sc Final Year Examination 2021

NAME	CGPA	NAME	CGPA
1. Alka Rai	8.62	17. Jyotishmita Ray	8.52
2. Anisha Devi	8.12	18. Kabita Sharma	8.51
3. Anwesha Das	8.33	19. Manjulika Bhuyan	8.04
4. Bhargab Pathak	8.32	20. Mridupaban Pathak	8.19
5. Bhrigu Das	8.12	21. N.Bidyut Jyoti Singha	7.48
6. Bitopan Kashyap	7.16	22. Nekib Ahmed	7.55
7. Debobrata Pal	7.62	23. Niku Barman	8.38
8. Deepsikha Haloi	8.80	24. Nikumoni Patgiri	7.99
9. Dishamoni Kakati	8.65	25. Partha Pratim Baruah	8.29
10. Harsh Rathi	6.86	26. Partha Pratim Kalita	7.93
11. Hemanta Kr Hazarika	8.30	27. Partha Pratim Das	8.30
12. Hibjur Rahman	8.33	28. Priti Harlalka	8.74
13. Hirakjyoti Sarma	7.58	29. Reema Sarma	7.54
14. Hirakjyoti Deka	7.59	30. Simi Choudhury	7.59
15. Jnyandeep Deka	8.46	31. Safikul Islam	8.49
16. Juliet Sarma	7.78	32. Suraj Paswan	7.83

Total First Class = 32 (out of 35)

The students of our Department who have secured First Class in B.Sc Final Year Examination 2022

NAME	CGPA	NAME	CGPA
1. Abhishek Dutta	8.47	16. Mihir Kumar Talukdar	8.89
2. Ankur Jyoti Kalita	9.51	17. Mriganga Kakati	8.19
3. Aparnab Baishya	7.62	18. Mustafa Iqbal Alomgir	7.07
4. Bhargab Deka	8.99	19. Nayan Jyoti Das	7.68
5. Bishal Deka	8.47	20. Purabi Rahang	9.11
6. Dhiman Kumar	8.86	21. Purbasha Bhardwaj	9.50
7. Dikshita Kakati	9.68	22. Rehena Mallick	9.64
8. Hemanta Boro	7.08	23. Rahul Boro	7.26
9. Jarshad Zaman	6.91	24. Reshab Basumatary	8.36
10. Joydesh Hojai	9.03	25. Sanat Kr. Rajbongshi	7.78
11. Jintu Deka	8.15	26. Saloni Poddar	8.84
12. Jubashish Gandhiya	8.27	27. Srijana Sarmah	9.14
13. Kizzka Athokpam	8.81	28. Suraj Das	8.28
14. L.Naresh Singh	9.31	29. Tridip Bhuyan	9.41
15. Mehdi Hasan	7.91	30. Ankur Raj Chutia	7.92

Total First Class = 30 (out of 30)

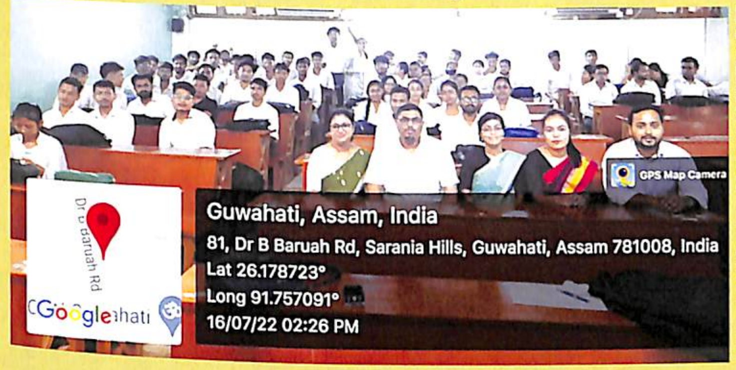
Ranks in Gauhati University (2022)
- First Class 2nd Position : **Dikshita Kakati**
- First Class 3rd Position : **Rehena Mallick**

Qualified JAM (2022) with flying colours
- **Bhargab Deka** (IIT, Dhanbad, Jharkhand)
- **Joydesh Hojai** (IIT, Palakkad, Kerala)

DEPARTMENT ACTIVITIES

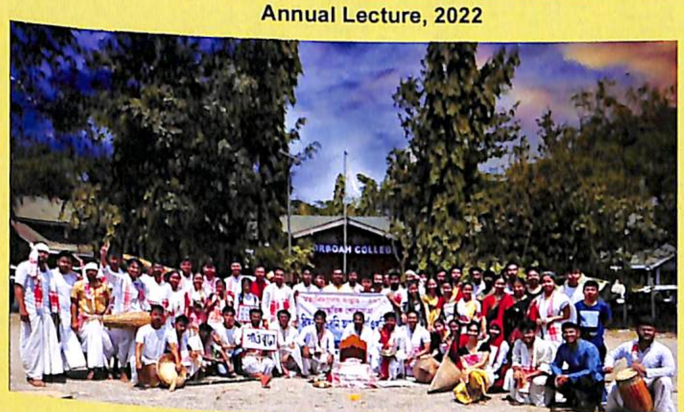
Department Beautification Program

National Mathematics Day Celebration, 2022



Annual Lecture, 2022

Department Picnic



Cultural Rally, 2022

Teacher's Day Celebration, 2022

Department Freshman Social and Farewell

6th Semester

4th Semester

2nd Semester