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Presidential Address

Relevance of Mathematical Sciences in National Development, its Current Status, Mathematics Phobia and its Prevention Strategies

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Introduction:

At the outset, I would like to express my gratitude to the Council and the members of the Indian Mathematical Society for electing me as the President for the year 2025-26. I feel humbled by this honour and it is a great privilege for me to address this august gathering of esteemed mathematicians and invited guests. I, on my own behalf and on behalf of the Indian Mathematical Society, would like to thank the Vice-Chancellor, Lucknow University, Head, Deparment of Mathematics Prof. Sahai for hosting the 91st Annual Conference of the Indian Mathematical Society : An International Meet. My sincere thanks to all the officials, funding agencies, volunteers, and all others who helped in organizing this event. I would also like to thank media person present here for covering the event.

The Indian Mathematical Society was founded on 4th April, 1907 by V. Ramaswami Aiyar with 20 founding members under the name "Indian Mathematics Club" having headquarter at Pune. The Society acquired its present name the "Indian Mathematical Society" in 1910, when it's constitution was adopted. There have been 78 Presidents of the Society till now. The Society started publishing research journal with the name "Journal of Indian Mathematical Society" from 1910. Celebrated renowned mathematician Srinivasa Ramanujan published his 12 papers in this Journal, the first being in 1910.The Society decided in 1932 to publish another journal with the name "The Mathematics Student". The J. of IMS aims at publishing high quality research papers, while The Mathematics Student aims at publishing Presidential Address, Plenary talks, Award lectures given in the Annual conference, survey and expository articles, popular articles, book reviews, problems and solutions, clever new proofs of known results etc.

The main objectives of the Society are to promote the quality research in mathematics, to inspire and encourage researchers, educators and students, and to popularize mathematics in India. The Society has been achieving these objectives by organizing Annual Conference, lectures, Symposiums, Award lectures, Plenary lectures, IMS sponsored lectures and by publishing The J. of IMS and The Mathematics Student. I feel that IMS has yet to do a lot for popularizing mathematics, specially among young students at High-School and +2 level which is the foundational stage for graduate level.

Mathematics is considered as one greatest and beautiful creation of human race. Mathematics has historically been India's Strength from Acharya Pingla, Aryabhat I, Bhaskara I, Varahamihira, Bramhagupta, Mahaviracharya, Sridharacharya, Aryabhat II, Bhaskaracharya II, Madhava, Neelkanth, Ramanujan, Mahalanobis, Shakuntala Devi, C.R. Rao, Harish Chandra, Manjul Bhargav and Akshay Venkatesh etc.

Role of Mathematical Sciences in National development:

In 21st century, mathematical sciences are not just for academic pursuit, but a strategy enabler of economic growth, technology innovation, governance and national Security etc. As India moves towards becoming a 10 trillion dollar economy and a global knowledge

hub by 2035, the role of mathematical Sciences becomes more vital and central. Key roles of mathematics for the development of our country are as follows:

(1) **Core of STEM:** Mathematics is the backbone of science, technology and engineering enabling technological and scientific breakthroughs.

(2) **Technological solutions:** Mathematical concepts, methods and tools are indispensable for the functioning of high-tech society allowing for the development of new and new technologies and more efficient systems.

(3) **Economic planning:** Mathematical models and Statistics are heavily used for economic forecasting, risk management, investment strategies and financial management, providing crucial data and its analysis for economic planning.

(4) **Increasing productivity:** Strong scientific and technological foundation powered by mathematics, lead to increased economic productivity and competitiveness for our country.

(5) **Engineering and design:** Modern designs and complex structures, especially in high-tech fields, require good mathematical understanding and numerical data, ensuring robust and efficient infrastructure.

(6) **Sector specific progress:** Mathematics supports development across all sectors including defence, education, healthcare and manufacturing by providing tools for data analysis, prediction and problem solving.

(7) **Artificial Intelligence and Machine learning:** During the last 2 decades, the need of machine learning and artificial intelligence has grown dramatically. This involves the need to analyse very large, high dimensional complex and unstructured data. Earlier graphs. and statistical tools etc. were used for data analysis. But they are not successful in analyzing such data. These days tools of Algebraic Topology such as persistent homology, persistent combinatorial Laplacians are used for shape analysis of such data.

(8) **Improving decision making:** A good grasp of mathematical concepts helps in improving decision making in governance, business, and in daily life, leading to more effective and systemic approaches to complex challenges.

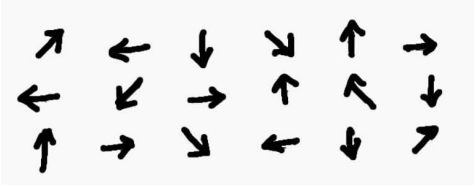
Realizing the potential of mathematical sciences in the rapid development, the International Congress of Industrial and Applied Mathematics (ICIAM) was established with its first meeting in Paris in 1987 with main objective to promote those branches of mathematics which are more relevant to economic, scientific, technological, and industrial development. In our country also, Indian Society of Industrial and Applied Mathematics (ISIAM) was established in 1990 to promote the teaching and research in mathematics with applications in science, engineering, medical & social sciences. and industries. ISIAM was affiliated to ICIAM in 2003. As per the recommendation of ICIAM and ISIAM, 18 important branches of mathematics need to be focussed to meet the objectives. They are computational mathematics, optimization, image processing, machine learning, artificial intelligence, financial mathematics, industrial mathematics, data analysis, nano mathematics, computer simulation, bio-mathematics, molecular modelling, prediction analysis, wavelets and their applications, fuzzy mathematics and applications, modelling and simulation for industries, agricultural mathematics, and environmental analysis. ISIAM publishes "The Indian J. of Industrial and Applied Mathematics" and relevant material to promote research, and industrial, economic and technological growth.

Role of mathematics in intellectual development and in enhancing disciplinary and moral values:

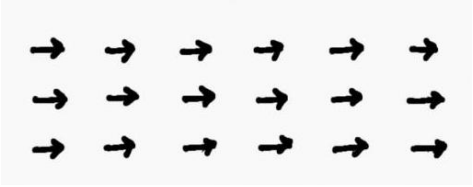
In mathematics, mostly we are given some hypothesis, a set of mathematical rules, a set of some known relevant results and from this one is required to prove some new result deductively or by method of contradiction. Analysing the given hypothesis, one proceeds step by step logically using prescribed rules of mathematics, and at times using cleverly some earlier known results judicially, and concludes the final result to be proved.

The habit of carefully analyzing the hypothesis, the habit of logically and truthfully applying prescribed rules of mathematics, the habit of proceeding step by step logically and the habit of judicially choosing and applying specific earlier known results to prove the final result, help in magnetizing the brain of a serious mathematics practitioner in the sense that analytical, rational, critical, logical, imaginative and innovative skills of the brain get enhanced. Thus a decent mathematics training helps significantly in intellectual development and acts as sharpener for the brain.

How mathematical training helps in enhancing organized and systemic thought may be illustrated by an example in physics about the process of magnetizing an ordinary iron bar. The only difference between an ordinary iron bar and a magnetic iron bar is that the iron molecules in the ordinary iron bar are spread in unorganized and haphazard manner, while the same iron molecules in the magnetic iron bar are arranged in organized manner as shown in the figure.



Iron molecules spread in haphazard manner in the ordinary iron bar



Iron molecules arranged in organized manner in the magnetic iron bar

When a magnet is rubbed “properly” on the ordinary iron bar, it also gets magnetized. In this process, the unorganized iron molecules of the ordinary iron bar get organized. Similarly, after practicing mathematics "properly", the unorganized thoughts of the brain get organized, making the brain more sharp and powerful.

Apart from mathematics playing a key role in national development, and mathematics with computer proficiency having a tremendous job potential in various sectors, I feel that the biggest hidden gift of mathematics is that a proper mathematical training helps significantly in making brain more powerful, sharp and imaginative, which is a key factor for being successful in any walk of life, be it administration, be it medical profession, be it engineering, be it scientist, be it teaching line, be it business, be it management, and be it even politics. Even enhancement of such skills of the brain may help in being a good father/mother, a good brother/sister, a good husband/ wife, a good son/daughter and a good friend as well.

Also, while practicing mathematics, one develops habit of truthfully following the rules of mathematics which helps the person to be more truthful, law abiding and disciplined in his/her day to day life. As mathematics deals with accurate and precise facts and

arguments with no scope of vagueness, it helps a mathematics practitioner to express his/her views on any topic more precisely, to the point and without any vagueness. Mathematics is universal and is not dependent on cast, creed, religion, country, and region etc. This makes a mathematics practitioner more open, broad minded, and unbiased. He/she may develop habit of universal acceptance without any bias of cast, language and religion.

Current status of Mathematics:

Despite the fact that mathematics has such a wholesome and universal role for the development, the status of mathematics in our country is not satisfactory, especially at the High-school and +2 level. There is a general perception among school students that mathematics is a dry, boring and hard nut to crack. This has caused a phobia for mathematics among most of the students. Some of the key reasons for maths phobia are as follows:

(1) Over emphasis on rote learning and memorizing, instead of understanding.

(2) Inadequate use of visual, practical or activity based learning

(3) Lack of real life connection with mathematical concepts, while teaching.

(4) Lack of participatory teaching. Students are discouraged to raise questions in the class.

(5) Absence of mathematics lab in schools.

(6) Lack of use of teaching aids like videos on mathematics, softwares (GeoGebra, Desmos), smart whiteboard and AI powered tutors etc.

(7) Lack of books and written material focussing on understanding of concepts, on connection of mathematical concepts with real-life situation, and on simple concrete applications.

(8) Some what heavy syllabus and pressure on teachers to complete syllabus in time, giving good result. This also causes stereotype and mechanical teaching without focusing on deep thinking, understanding and and creativity.

(9) Marking questions on the basis of final answer, not on the procedure. Even if procedure is correct and due to some unforeseen mistake in addition or subtraction, if answer is wrong, mostly zero mark is given. Such harsh and irrational marking causes frustration turning to fear with mathematics.

(10) Multiple choice or True/False questions with very little time create undue pressure on students to get right answer quickly. This discourages deep and cool thinking. Students start believing that mathematics is for quick thinkers and intelligent ones.

(11) Considering marks as sole criteria for intelligence and success by teachers and parents forces students to get more marks by hook or by crook without focussing on understanding.

(12) Examination system mostly tests. memorization potential, no reasoning, understanding, and creativity.

Some Suggestions:

In order to reduce mathematics phobia significantly, and in order to make mathematics more student- friendly, I would like to give some suggestions.

(1) The focus of mathematics teaching needs to be shifted to mathematizing the thought process of students i.e. to develop clarity of thought process, to enhance systemic, analytical, critical, rigorous, logical and creative skills of the brain.

(2) Effort should be made to use charts, models, demonstrations, hand-on activities, softwares like GeoGebra, Desmos, Nearpod etc, smart white board, and mathematics videos etc to convey mathematics in interesting manner.

(3) Effort should be made to relate mathematical concepts with real-life situations to help students get convinced that mathematics is not just an abstract subject, but also has relevance to our real lives.

(4) Mode of assessment in tests and examinations should be changed to test the understanding of the subject matter instead of cramming ability.

(5) Participatory teaching needs to be encouraged. Students should be encouraged to ask questions.

(6) Frequent training programmes for teachers need to be organized regularly to update them with new text, procedures and techniques, and also update them with the use of softwares, smart whiteboard etc. This will help teachers to convey mathematics in student-friendly manner.

(7) Writing of good books and teaching, learning material, giving emphasis on understanding, explaining mathematics underlying various procedures along with brief historical notes and some simple concrete applications, and connection of different concepts with real-life situation is the need of hour.

(8) Inserting some humours, healthy relevant jokes, puzzles, paradoxes, fallacies, some recreational aspects of mathematics in between lectures help in making the class lively. Similarly, narrating some short stories or interesting incidents about great mathematicians and scientists or interesting stories about some discoveries in between serious mathematics may help in keeping the attention of students intact on one hand, and in letting them know about great mathematicians and discoveries on the other hand, which is likely to create interest, and inspire students.

(9) Students should be encouraged to solve some difficult problems in group. Collaborative project work should also be encouraged.

(10) Mathematics lab should be established in schools, which may help in understanding mathematics better through hand-on activities.

(11) In order to train the school teachers, we need to have a National Mathematics Master Training Programme to ensure creating a set of Master trainers in each district.

(12) We may create Mathematical Mentoring Circles, i.e., networks of experienced mathematics educators who may support school teachers online for best teaching practices and resources etc.

(13) It may be good idea to introduce online school teachers communities for sharing their practices and problems.

(14) Somewhat overloaded syllabus in mathematics may be reduced to ensure more time to focus on core competency, logical and analytical reasoning.

(15) One or two lines short justification should be made mandatory for multiple choice or True/False type questions to ensure whether student has ticked the answer by guess or by proper reasoning.

(16) The university and college teachers may be requested to interact with school students and teachers through periodic talks or discussion.

(17) The world of mathematics is full of wonders, easily understandable, and amazing stuff which are very interesting and do not involve deep mathematics. It may be good idea to supplement classroom teaching with fortnightly popular talks on such stuff giving inside beauty and elegance of mathematics.

(18) School libraries should buy some books on recreational and popular mathematics, and students may be encouraged to read such books in their leisure time. This will certainly help create interest in mathematics

(19) For Various activities and measures mentioned above to be taken in order to make mathematics more palatable, teachers may need more time. One additional class per week for mathematics may fulfil the requirement of additional time.

(20) Through understanding oriented and participatory teaching, using various teaching aids, and giving real-life examples and applications, students will start finding interest in mathematics and will be convinced that although mathematics may be somewhat hard nut to crack, but once it is cracked, one will find inner beauty, elegance and wonders in mathematics. In fact mathematics is like hairy, shabby looking hard coconut from outside and is quite hard to crack, but once it is cracked, one gets sweet and white coconut meat and sweet nutritious coconut juice.

With these words, I would like to once again thank the council members of IMS for electing me as the President of the Society for 2025-26, and thereby giving me an opportunity to share my views on "Role of Mathematics in National Development, its current status, Mathematics Phobia and its Prevention Strategies". I would also like to thank once again the Vice-Chancellor of Lucknow University, Head, Mathematics Department and all officials of the University for organizing this conference in such a grand manner and also to media persons for covering this event.