

My journey towards being a mathematician

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I was born on 1st February, 1980 at Khangabok Awang Leikai, Thoubal District of Manipur. I am the eldest of five children of (late) Laishram Mahajon Singh and Laishram Sanahanbi Devi and now married to Dr Kabita Waikhom Laishram and now father of two lovely daughters Amy and Yaipha. My father studied up to Class 8 and ran a Cycle workshop and my mother is a homemaker. Though we had our own land and paddy fields, we just had enough to fend for ourselves and we were financially poor. However, my father took a keen interest in my study and encouraged me a lot to study.



My father and family with wife and two daughters

I did pre-primary schooling from Amusana Boys LP School in locality in Khangabok Awang Leikai. Here I would recall an incident. Unlike current schools, we didn't have proper benches and we used to take our sacks to sit and study on the ground. In the beginning of the year before Class I, I finished reading and studying all the books myself and then I cried and requested that I should be promoted to Class I. The teachers took my test and then agreed to promote to Class I. I was happy to study with my locality elder kids and also topped Class I and 2. From Class 3 to 5, I studied in Khangabok High School (currently Khangabok Higher Secondary School) which is a Manipuri medium government school in my village Khangabok. There also, I was among the top 3 and I was ahead in maths from everyone and in fact finished solving all the math textbook questions before the academic year end, sometimes neglecting other subjects.

I wrote the Jawahar Navodaya Vidyalaya Selection test in 1990 and got admission at Jawahar Navodaya Vidyalaya, Sandumba Achouba, Kakching (JNVSAK), Thoubal district where I studied from to study Class 6 to 12. My student days at JNVSAK from 1990 to 1997 really helped me in shaping my career and personality. Apart from academic studies, I was an avid reader, read almost all the novels and books other than school textbooks in the library and was given the best reader award in the school. I was not so much interested in sports and arts and music. However, I was keenly interested in Quizzes, essay writing, extempore speaking and debates etc where I got a number of prizes and also represented school in District and state level competitions. In academics, I was doing very well and of course, interested in mathematics much more than other subjects. I got 99 out of 100 in Class 10 CBSE exam in 1995 and that motivated me to study more

mathematics, sometimes neglecting other subjects in Class 11 and 12. In fact I was the kind of man to go for any math questions during Class 10-12. At that point of time, I was interested to join NDA to become an Armed Forces Officer and cleared and NDA written tests even during Class 11, which I wrote. However, I was not selected in the SSB interviews I went for, after my Class 12 exam.

My interest in mathematics grew much more after I was selected to appear for Indian National Mathematical Olympiad (INMO) exam in 1996 when I came into contact with Dr. Jayantakumar from DMSc, Imphal first and then Prof. M. B. Rege from NEHU Shillong. My one week stay at NEHU Shillong before the INMO exam, preparations and problem solving sessions really helped and motivated me to pursue mathematics later on. Considering my financial situation at home, I decided that I will try for IIT Entrance exam for Engineering and if I could not get through, I will study BSc Mathematics and write Civil Services.

In 1997, I joined DM College of Science (DMSc), Imphal, Manipur for B.Sc. Mathematics Honours degree. That year, unfortunately, there was question leak in IIT Entrance exam. On one of the new rescheduled day, around the same time, DMSc Admission test was also there. I first wrote for DMSc Test, finished the exam in 30 minutes and rushed to ITI Takyel to write IIT Admission test which was delayed by bit more than 30 minutes. Of course, I didn't get through IIT and instead topped the DMSc Entrance. I joined BSc and started planning for writing Civil Services exam after BSc. During BSc, I got lot of support and encouragement of teachers that time, particular oja Jayanta and also from oja Prof. M. Ranjit Singh of Manipur University, among others.

I was staying in the DMSc hostel. Usually on Sundays, we all watch the TV together in the hostel. On one such Sunday, while watching Cricket Match in DD Channel, there was an advertisement for Mathematics Training & Talent Search (MTTS) Program. I noted the address and requested for application form by sending a letter to Prof. Kumaresan who is the program director of MTTS. Once he sent the form to me, I filled it and posted it back with required reference letters. I was lucky to get selection in MTTS Level 0 at IIT Madras in May-June of 1998.

In the summer of 1998, I went by bus from Imphal to Guwahati which takes around 1 day and then train journey for 4 more days from Guwahati to Chennai to attend MTTS 1998 at IIT Madras. That was almost my first solo journey outside Manipur. However, the 4 weeks' program at IIT Madras

was one of the turning points in my life and career. I became aware of some of the well-known institutions in India and got to know also that we can make a career in mathematics. The exposure there, training in how to think and approach mathematical ideas along with meeting faculties from well-known institutions in India and student peers from all over the country changed my outlook and increased my resolve to be a mathematician. After MTTTS in 1998, I got selection to attend two further levels, MTTTS Level I and MTTTS Level II in 1999 and 2000 at RIE Mysore.



MTTTS 2020 at Mysore

In MTTTS 1998 at IIT Madras, I met Prof. SD Adhikari from HRI Allahabad. He was kind enough to invite me as a visiting student at HRI Allahabad for 2 weeks in 1999 for learning new mathematics. I got a sense of what is a research institution during my visit. He has been a mentor to me since then.

I was selected for Summer Research Fellowship Program(SRFP-1999) by Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore and was also awarded the ***Rajiv Gandhi Science Talent Research Fellow***. I got to spend 2 months working under the guidance of Prof. R. Balasubramanian of the Institute of Mathematical Sciences (IMSc), Chennai in the summer of 1999. That was an enriching experience for me and with that my resolve to become a mathematician grew stronger.

In 2000, I applied for VSRP program of Tata Institute of Fundamental Research (TIFR) Mumbai. Instead I was shortlisted for written test for Research Scholarship at TIFR Mumbai. After attending

the MTTS 2000 in RIE Mysore, I went to Mumbai for the written test. I had a sleeper class ticket to go to Mumbai. On the day of the travel, I go to know that my train ticket has been cancelled and refunded. So, I booked a waitlisted ticket. I had become very good friends with some of the MTTS participants from Mumbai already and luckily, I was able to travel to Mumbai with them without much trouble. Also 2 of my friends, Swaralipy and Aaloka offered to let me stay with their families and that way, I didn't *feel alone* in the big Mumbai city.

In June 2000, I went and gave the written test for research scholarship, which is an objective true and false test, with negative marking. After the test, some of us were shortlisted for interviews and I gave interview on the second day in the afternoon. It went well. TIFR gave some reimbursement of travel and incidental expenses and while going to the Aaloka's house, I was pickpocketed in Kurla Station and lost almost the whole amount of money. Luckily, before I departed Mumbai for Manipur, I got information from my good friend Ritumoni Sarma, who was research scholar at TIFR that time and whom I knew from MTTS 1998, that I was selected as a research scholar at TIFR Mumbai. Therefore, I came back very happy.

Soon after, I got a telegram informing officially of my selection as a research scholar and asking me to join by August 2000. By that time, I was still in 3rd year of my BSc and final exams were to be held in 2001, because of delay in academic schedule that time in Manipur. However, my teachers at DMSc encouraged me to go and join TIFR and come back from final exam later on. Then I took necessary permission from DMSc and Manipur University and joined TIFR Mumbai as a first year research scholar in August 2000. In January 2001, I came back to Manipur and gave final year BSc exams to get my BSc Degree.



Office at TIFR Mumbai

During PhD program at TIFR, I had courses in Algebra, Analysis and Topology in my first year till December 2000. Because of semester leave during January to June 2001 to complete my BSc, my actual first year coursework started again in August 2001. In maths, we had to give first year interviews which was considered toughest in TIFR and research scholars were even asked to leave if their performance was not satisfactory. After my first year coursework, I did some reading courses in Number theory with Professor TN Shorey and formally joined him for PhD. I was mainly working in the area of Diophantine equations. During my PhD Program at TIFR, I was a *Kanwal Rekhi Career Scholarship* holder.

I wrote a thesis titled "*Topics in Diophantine equations*" under the guidance of Prof. Shorey and got my MSc by Research degree from Mumbai University in 2004. Finally, in July 2007, I got Ph.D. Mathematics (Number Theory) in July, 2007 from School of Mathematics, Tata Institute of Fundamental Research, Mumbai, India. The title of thesis was "*Refinements, Extensions and Generalisations of a Theorem of Sylvester on the prime factors of a product of consecutive integers*". I was also awarded the *TAA-Harish Chandra Award for Best PhD Thesis in Mathematics* at TIFR Mumbai.

Career after my PhD:

After my PhD in Mathematics, I worked as a Post-Doctoral Fellow at Department of Pure Mathematics, University of Waterloo, Canada from August, 2007 to August 2009. I was also academic visitor at Max-Planck Institute for Mathematics, Bonn, Germany during August-October, 2008. I joined Indian Institute of Science Education and Research (IISER) Bhopal as Assistant Professor and was there from December 2009 to May 2010 and was an academic visitor to ETH Zurich during May-June 2010. In July 2010, I joined Indian Statistical Institute (ISI), Delhi as an Assistant Professor of Mathematics. In December 2015, I was promoted to Associate Professor and in December 2020, I became a full Professor at ISI Delhi.

At ISI Delhi, I am mainly involved in mathematics research, teaching Masters and PhD Courses and guiding students. I was awarded *Microsoft Young Faculty Award 2010-11* jointly by Microsoft Research India and Indian Statistical Institute. At ISI Delhi, I worked as Hostel warden and was

also an Associate Dean, Academic Affairs. Currently I am Head of Theoretical Statistics and Mathematics Unit (TSMU), Indian Statistical Institute, Delhi.



ISI Delhi

Research:

My area of research interests is primarily in Number theory. I am interested in areas of Diophantine Equations, Binary Recurrence Sequences, Sum of digits, Irreducibility of Polynomials and Inverse Galois Problem. Arithmetic Dynamics, Prime Numbers and Cryptography, particularly, the number theoretic aspects of Cryptography. In fact, I am interested in any area of number theory and related areas where I can use my expertise and where I can learn and make new contributions.

A Diophantine equation is an equation, typically in two or more unknowns with integer coefficients, in which we seek only integer solutions. Linear Diophantine equations in two variables are well understood. However, solving Diophantine equations of higher degrees and/or many variables has been one of the most important and difficult problems in mathematics. Lots of new ideas and different areas in Mathematics in general and number theory in particular have been developed trying to solve a number of Diophantine equations. A case in point is the well-known Fermat's Last Theorem: there are no solution in non-zero integers x, y, z of the equation $x^n + y^n = z^n$ where n is a positive integer exceeding 2. My work was mostly on explicitly solving exponential

Diophantine equations using a number of techniques and ideas, ranging from analytic, combinatorial techniques, linear forms in logarithms, modular techniques etc.

Apart from teaching and research, I like mentoring and guiding students. I have taught Undergraduate, Masters and PhD courses at different places. I have officially guided 2 PhD students and a number of undergraduate and Masters projects, with students from different institutions in India. I am a Research Co-Guide of IIT Delhi and Manipur University.

I have published more than 45 research papers in international refereed journals. I am also involved in a number of national and international research projects including projects with France, Mexico and Hungary. I was an *Erasmus Mundus Scholar*, University of Bordeaux, France in 2013. I have also refereed papers for a number of International journals. As part of my research, I have travelled and lectured at number of institutes and universities in India and abroad. I have organised a number of workshops and conferences at different levels.

Mathematical Olympiad activities:

I have been keenly interested in Mathematical Olympiad. During my PhD, I gave some lectures for INMO qualified students at IMOTC in Homi Bhabha Centre for Science Education (HBCSE), Mumbai. Recently, I have been getting more involved in India national Olympiad program. I was *NBHM Olympiad fellow* for around 2 years and I was also a *Deputy National Coordinator for Olympiad Activities*, NBHM, Govt of India. Currently I am a member of the *Olympiad Activities Committee*, NBHM, Govt of India.





I have organised Olympiad workshops and also gave lectures at a number of training camps. I was a Deputy Leader of Indian team to European Girls Mathematical Olympiad (EGMO) 2018 in Kiev, Ukraine, which is exclusively for girl students. I was also a Deputy Leader of Indian team at the main International Mathematical Olympiad (IMO) 2022 at Oslo, Norway. I also went to IMO 2023 at Chiba, Japan as a Problem Coordinator from the IMO side.



How is it being a mathematician?

A person who does mathematics is a mathematician. Unlike many other areas of science or engineering or other fields, mathematics is something which you can do all over your life. Paul Erdos, one of the most prolific mathematicians of the last century, rightly said:

Mathematicians never die, they just stop doing mathematics.

A working mathematician is person who contributes in the advancement of mathematical knowledge by way of teaching, research and sharing knowledge. To become a mathematician, one needs to be trained in mathematical thinking by way of exposing to different areas and needs to learn a lot of related materials.

One interesting aspect of being a mathematician is to get opportunities to travel and interact with mathematicians working in related areas from all over the world. I have been lucky enough to

travel at many important places in the world. In fact, I have travelled to more than 20 countries in the world! As such, one has the enough freedom to work anytime and anywhere. Of course, sometimes you may be thinking on a problem and you may continue to think on that even when you are walking or eating, without bothering about other things. However, the real joy is when you get an interesting idea to solve a problem. Perhaps this prompted Hardy to say

“If I could find a proof that you were going to die in five minutes, I would of course be sorry to lose you, but the sorrow would be quite overweighed by the pleasure in the proof.”

while talking to Bertrand Russell. Russell entirely sympathized with him and was not at all offended! But one thing which we have to remember one thing:

there is no substitute for hard work and patience pays.

Personal interests:

Apart from mathematics, I am interested in environmental issues, likes travelling and watches lot of movies. In fact, I have travelled to Indonesia, Japan, Laos, Myanmar, Philippines, Thailand and Turkey in Asia; South Africa in Africa; Austria, Belgium, France, Germany, Greece, Hungary, Netherlands, Italy, Spain, Switzerland and United Kingdom in Europe; Canada, Mexico and USA in North America and Brazil in South America. In fact, travel is a motivation to work more for my mathematics research. I also read a lot and like to keep a track of latest happenings in the world of politics, environment and science.