



# MATHEMATICS TRAINING AND TALENT SEARCH PROGRAMME

(CONDUCTED SINCE 1993)

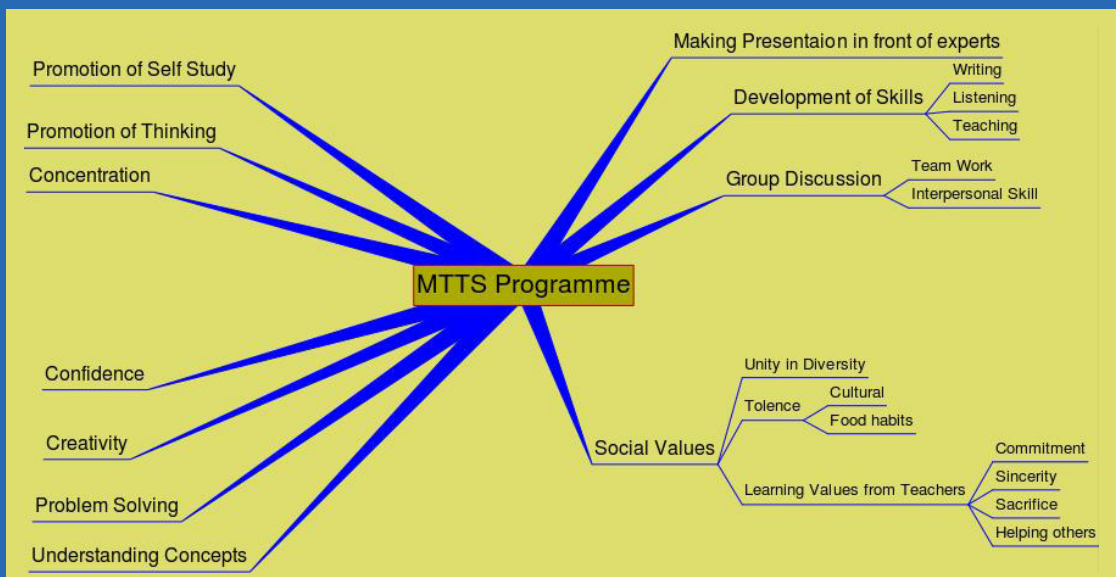


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## SOME OF THE MTTs VENUES IN THE PAST



## BENEFITS OF MTTs PROGRAMME (AS PERCEIVED BY THE STUDENTS)



## INTRODUCTION

The Mathematics Training and Talent Search (MTTS) Programme is a four week intensive summer training programme for undergraduate and postgraduate students in India. This programme has been conducted, since 1993, at various centres in India. The programme is funded by the National Board for Higher Mathematics (NBHM), an apex body of the Department of Atomic Energy, Government of India.

During a 'Discussion Meeting on Harmonic Analysis' held at the Indian Institute of Science (I.I.Sc) Bangalore in 1992, a session was devoted for discussing the academic preparation of the students who come for Ph.D. programmes in Mathematics to various universities and Institutions in the country. To improve the level of the Ph.D. aspirants, it was felt that a training programme should be started at the B.Sc. final year level, to expose young minds to the excitement of doing mathematics and enabling them to pursue a meaningful career in mathematics (research and/or teaching). The programme, christened as the Mathematics Training and Talent Search Programme (MTTS), was launched in 1993, with financial support from NBHM. Since then, the programme has been organised under the Directorship of Professor S. Kumaresan, (formerly from University of Mumbai), Department of Mathematics and Statistics, University of Hyderabad, India.

### Some of the main aims of this programme are:

- to expose and attract young minds to the excitement of solving problems in mathematics and choosing mathematics as a career;
- to promote independent thinking;
- to provide a platform for talented students through which they can interact with their peers and experts in the field
- to improve the teaching methodology for mathematics in the country in the long run

The programme has three levels: Level-O, Level-I and Level-II. Level-O is meant for first and second year undergraduate students of mathematics, Level-I for 2nd and third year undergraduate students and Level-II for the first year post graduate students.

The Levels I & II have lectures in the four basic streams of Mathematics: Algebra, Analysis, Geometry and

Topology. Students of Level-0 are offered courses in Basic Real Analysis, Linear Algebra, Geometry (curve tracing, sketching of surfaces and classification of quadric surfaces) and one of Discrete Probability, Combinatorics and Elementary Number theory.

MTTS is conducted every year in summer (May-June) for four weeks, at several centres in India. Usually, there is one main centre, where all the three levels are held. Level-O is conducted at many (about three) centres.

## TEACHING METHODOLOGY

The teaching methodology adopted for this programme is different from standard class room teaching. The faculty is discouraged to deliver well polished lectures. The principle followed in this programme is best explained by the following quotes

*The only instruction which a teacher can give, in my opinion, is to think in front of his students.*

-- Henri Lebesgue

*The art of teaching is the art of assisting discovery.*

-- Mark van Doren

*It is the supreme art of the teacher to awaken joy in creative expression and knowledge.*

-- Albert Einstein

All sessions are highly interactive and the students are discouraged to take notes; rather they are encouraged to think along with the teacher. Rarely a definition is introduced to the students. Often they are given a lot of examples and they come up with a definition, which abstracts properties seen in the examples. With a lot of examples, leading questions and visual aids, such as diagrams, the students are trained to observe patterns, formulate a result or a conjecture and finally look for a proof.

When a new concept is introduced or a new result is proven, students are given typical situations or problems. Many examples are given as soon as new definitions are made and the students have to verify that they are examples of the concept just introduced. Only if the teacher is convinced that the majority has understood s/he proceeds further. Sometimes, another teacher, who is present in the class, may try to explain things in his/her own way. This gives different perspectives to the concept. (To achieve this, the



Student assisted by another student during student seminar



Student is assisted by a faculty during student seminars



faculty members, who will be willing to work as a team, are selected for delivery.) The teacher makes cross-references to analogous/similar results/concepts, explained by his/her colleague for the programme.

Usually, students are given an outline, strategies or the idea of the proof and they are asked to work out the details in the class itself. Such exercises are to be submitted as writing assignments, with complete details. The students are encouraged to discuss among themselves before writing the final proof. This advice has two benefits; (i) those who did not understand or could not work out the complete details will have an opportunity to learn them thoroughly by discussing them with their peers (ii) those who did understand get a chance to enhance their communication skills and consolidate their understanding, can do so while they explain or clarify the doubts of their friends.

It is universally true that whenever a teacher asks a question, some of the bright students tend to answer it aloud. The other students gradually comes to a stage in which they do not even try to understand the question and answer it on their own, as they know that some of the good students will give the answer. To prevent this, the policy followed in the MTTTS programme is that all students should write the answer very briefly; this will then be examined by the instructors present in the class. This allows us to identify the problem area of the students in the very beginning and take remedial measures.

Student Seminars are an integral part of this programme. After two weeks one of the sessions is completely devoted to student seminars. The topics of the seminars are either chosen by the student or assigned by the teachers, taking his/her background into account. This serves many purposes; (i) it builds the confidence level of the students, (ii) it eliminates stage fear and the fear of expressing themselves before experts.

Invariably while presenting in seminars, the students follow the methodology of MTTTS, by making it highly interactive. In fact, in some of the student seminars, hardly anything is written on the board. This aspect of MTTTS is so popular that almost all students volunteer to conduct seminars, so much so that it is difficult to accommodate them all.

Since the last few years, after one week or so, students are divided into groups of 4-5 and are encouraged to discuss

topics. At times, each group is assigned some topic for discussion, which they need to present at the end before the class. This feature has been so successful that students want more time for group discussions.

In each level, almost every day one writing assignment is given to students, which is critically evaluated by the concerned teacher. The assignment is discussed either with the entire class or individually. During the MTTTS camp, we insist that students discuss the day's happening with their peers. The faculty stay on campus and have dinner along with them. This gives a chance to students, to interact with the faculty outside the classroom, both at the professional and personal levels. This results in a better rapport between them.

It is an avowed policy of MTTTS not to hold any written exams, but to encourage students to learn mathematics for its own sake. However, the students are informed that their performance will be critically evaluated by the teachers. The teachers of the particular level collectively award a grade to each participant, which will be disclosed to a student if s/he wants to know it. It is a matter of great pride that no student 'fails'. Each student feels that individual attention is paid to him/her, thanks to the steps mentioned above.

## SELECTION OF STUDENTS

Out of more than 2000 applications received each year, about 230 students are selected for the programme. About 180 actually participate. The selection of students depends mainly on their consistent academic record and the recommendation letter of a teacher, closely acquainted with the student. The selection is highly influenced by specifics rather than by the general remarks in the recommendation letter. While selecting students, regional and rural backgrounds are also given importance, so as to give opportunities to students from all regions and to those, who lack exposure to good teaching, peers and good textbooks. In fact, due to this consideration, the Level O of this programme is also arranged in different parts of the country. As a rule, not more than two students from the same college/institution are selected. If a former student applies for the next level, his/her performance in the previous level is the most decisive factor. As there are regional imbalances in the grading pattern, applicants of the same region are



Students Seminar, MTTTS 2012, IIT Kanpur



Students Seminar, MTTTS 2012, IIT Kanpur

Group Discussion, MTTS 2012 (IIT Guwahati)



Group Discussion, MTTS 2012 (IIT Kanpur)



collected and scrutinised together. We make a shortlist from this, which will be compared with similar shortlists. Usually, the first two rounds are elimination rounds. The next two rounds are comparison with other shortlists of the same state and states with a similar grading pattern. The penultimate round is at the national level. The final round takes care of regional representation.

Level O students are assigned centres, which are close to their institution or home. To encourage participation by girl students, we make it a policy to select two students (preferably another girl) from the same institute. But for this policy, many parents would not permit their daughters to participate in this programme held at a 'far-away' place from their home.

## FACILITIES

The selected candidates are provided with sleeper class return train fare and free lodging and boarding. They are also given reading material and a few books. MTTS spends about 15 to 20 thousand Indian rupees (approximately 300-400 USD) on each student. Since several years, we provide them an electronic version of the notes, along with some free and open source mathematical software.

## CHALLENGES

The major difficulty for this programme is to find dedicated faculty, who can work as a team and who can spend their valuable time for all four weeks, at the MTTS Camp. MTTS has been organised year after year, with the help of a very small group of dedicated people, who want to improve the scene of Mathematical teaching and research in India. Our hope is to solve this problem, by encouraging former MTT participants, who are now faculty members, at various institutes, to serve as resource persons for the programme.

While selecting the students for the MTTS programme, we have the challenge of selecting the most deserving candidate. Many a times, the recommendation letter is very generic, which makes it difficult to make a choice. In such cases, we compare the academic achievements of the shortlisted candidates and make the selection. At times, rejection is very difficult.

Since the participants come from all over the country,

many students have language problems, as the medium of instruction is English. Even though the students might have been taught in English in their home institute, many a times, their teachers resort to explaining the concepts in their regional language. The absence of this practice in the MTTS camp leads to some difficulties for the students. Even for those, who are reasonably comfortable with English, the differences in regional accents pose problems in understanding. However, the programme attends to these problems. As regards the second issue, the students are assured that they will get used to the accents and that they should not be unduly bothered. Every effort is made to identify students with language difficulties. Such students are assigned a teacher, who can possibly communicate with them in their own language. The faculty members at every level are carefully chosen, so that we can ensure that they can communicate in different languages. As a result, no participant feels left behind, due to language barriers.

Given the innate bureaucratic nature of the academic institutions in India, it is difficult to find a suitable venue, with accommodation, to organise the programme.

In spite of our best efforts, we do not think that MTTS has reached every nook and corner of the country and lot more needs to be done at the local level. Usually, we get more applications from the same set of institutions from the same set of states. In fact, there are some states from which there are hardly any applications. At times, we select a student just based on regional consideration, even though his/her academic records may not be comparable to others. This gesture serves as an advertisement for MTTS, so that in future students of that region apply.

In order to provide opportunities to a large number of students at regional levels, we have launched Mini-MTTS programmes, which are modelled after the MTTS Programme, but are of a shorter duration and they cater only to students of the region, in which the programme is held.

In order to spread the MTTS methodology to large number of students, we have started a new scheme – 'Pedagogical Training for Mathematics Teachers (PTMT)'. The suggestion for this came from the participants. The participants of PTMT are introduced to the MTTS methodology, so that they can adopt it in their regular





Team work of teachers



Students Discussing with Faculty in the Guest room on Sunday

teaching.

In the first few years, some of the top performing participants of the MTTs camps were selected for very intensive training, in a topic or two of considerable depth, in the leading institutions of the country. This follow-up programme was discontinued for the following reason - the fountain-head of the flow of the research students to the leading departments and institutes of this country is MTTs. In spite of that, the contributions from these institutes, either to the main programme or to the follow-up programme is almost non-existent.

## EVOLUTION OF MTTs

The programme continuously evolves, thanks to the extensive feedback sought from the faculty and the participants.

To begin with, the MTTs programme was started only for Level-I and Level-II students, at only one centre. The need for starting the training even earlier was realised and Level-O was launched in the year 1995. Since then, Level O is simultaneously conducted at different places, in order to enable students from different parts of the country to participate in the programme.

In the beginning, morning sessions were devoted to instruction, whereas afternoon sessions were for problem solving. In order to make the session more interactive, the lecture and problem solving sessions are now combined. This also ensures that the teachers are more interactive in the classroom and keep a certain pace, so that students can follow the course.

To provide a proper grounding in fundamentals, we introduced a course in foundation in Level-O, which mainly deals with logic, concept of a proof and a rigorous acquaintance with sets and function etc. This also serves the purpose of introducing standard examples, which arise naturally in mathematics, rather than giving contrived/artificial examples. We have started giving daily writing assignments, which gradually increase in difficulty, as the programme progresses. This trains the students in writing/solving mathematics on their own, rather depending upon notes and books.

As, mentioned earlier, since several years, one session

is completely devoted to student seminars and no compromise is made on this account. This has been highly successful and appreciated by one and all.

We have also introduced group discussion sessions, at all the levels, so that the students interact among themselves and discuss the day's happenings. At times, each group is assigned some topic for discussion, which they need to present at the end, before the entire class. This feature has been so successful that students want more time for group discussion.

Since the last few years, on the inaugural day, a questionnaire is circulated to Level-I and Level-II students. Based on their answers, the students are counselled and appropriate courses are suggested to them. It is possible that a student may have to attend one subject with one level and another subject with another level. To make this feasible, the time table is suitably framed.

Moreover, students are given a feedback form at the end of the first week. The idea behind this is that students assess their own efforts and involvement in the programme. This has resulted in some of the laggards getting their act together and performing better, as seen by their own admission in the final feedback form.

To keep pace with the changing mode of communication, we have introduced online applications. However, we still continue to accept applications submitted in the traditional way. We also encourage many activities, shorter in duration, modelled after MTTs, to be organised at many places, in the country.

## FEEDBACK FROM STUDENTS AND TEACHERS

MTTs is a great programme to channel mathematics talent from all over India, by exposing bright young students to rigorous mathematics, terrific teachers and a charged environment. The MTTs experience is memorable, creating numerous opportunities for students and motivating them to choose their careers in mathematics. In addition to propelling students towards research careers, it has influenced a generation of mathematics teachers all over India.

--Dr. Abhijit Champanerkar, City University of New York, MTTs 95 & 96

I think attending MTTTS was one of the turning points for me, it helped me gain clarity in thinking and also helped me to gain a broader attitude towards life.

**--Saurabh S. Bhangaonkar, Connizant Technology Solutions Ltd. Pune, MTTTS 2000**

It was very helpful in kindling my individual thinking, through which I realised the joy of mathematics, which in turn motivated me to aspire for a career in mathematics.

**--- Lakshmi Priya ME, MTTTS 2007-2009**

When I look at myself as I was three years ago, I see radical change in myself. The way MTTTS teaches its students, the way it motivates them to study on their own, and effectively at that, is really amazing. This is the only programme in the country at the undergraduate level, which helps students coming from various parts of the country, with various backgrounds, to reach a specific level, from which they can carry on.

**--Anand P. Sawant, MTTTS 2006-08.**

I am back to my routine after MTTTS2010 at HRI. I have really gained a lot from the programme. I can feel that my approach towards mathematics has changed. Now that my college has started, I can see that I can do whatever is being done in the class without a pen and paper. I have started thinking along with the teacher and I clear my doubts then and there. It was a very useful programme. I could also feel that my interest in the subject and confidence level have increased.

**--- Nethra Neelakandan, Level O, MTTTS 2010, HRI.**

After attending MTTTS, each and every class, I attend in my college is very different from the class I attended till last year. Every single problem I solve, I am able to think about it and then solve it.

**---Padmaja G., Level O, MTTTS 2010, Mysore**

MTTTS is a programme, where emphasis is laid on developing 'thinking ability' in mathematics. Although presently I am not directly working in Maths, the 'thinking ability' that I could develop during the MTTTS programme, always helps me solve problems (both mathematical and non-mathematical).

**--Rajesh Kumar, Directorate of Forensic Science, MHA, Govt. of India, New Delhi, Level I, 2003**

I feel that the most important contribution of MTTTS is that it brings out a significant change in the student's perspective about learning mathematics. I have seen a drastic, positive change in my students after they return from MTTTS. They develop an outlook towards learning the subject and the confidence that they can learn the subject on their own. Most of the MTTTS students, from my college, are performing exceedingly well, in their fields, including teaching, research, math education, industry, etc.; and a large share of their creative working goes to MTTTS.

As a teacher, I am immensely benefited by the programme and always got more insights in teaching-learning processes from my colleagues and students. The programme has brought out a revolution in undergraduate mathematics in India and I am sure that it will continue to do the great work. My Best Wishes !

**--Prof. V. M. Sholapurkar, S.P. College, Pune**

## IMPACT OF MTTTS

At the end of the programme one can see remarkable improvement in a student's independent thinking ability and mathematics writing and problem solving ability. The whole approach of these students towards mathematics changes, after four weeks of extensive training in this programme. Students' feedback taken at the end is a reflection of these effects.

Over 2500 students have gone through the MTTTS programme, of which about 300 students have gone on to obtain their Ph.D. degree or are in the process of completing the degree. Many of them have gone on to do their doctorate at prestigious research institutes in India and abroad. More than 1200 would have gone on to become mathematics teachers at various levels, starting from high school to the university level.

This programme has created a great impact on the mathematical scene in India. To quote senior mathematicians, attached to research institutes in India, 'Earlier, when we interviewed candidates for Ph.D., we would be happy to find 2 or 3 out of 100. Due to the efforts of the MTTTS programme, we now interview about 30 to 40; none of them is a dud; we can see that they are confident of tackling unseen problems and have a clear







Mini-MTTS 2012 at Kerala



ICM 2010, Hyderabad, MTTS alumni

understanding of the concepts and all of them can be traced back to MTTS'.

If one visits any elite institute or university in the country, one can find a few MTTS students, pursuing their Ph.D. in mathematics or those, who have become faculty. In fact, in most of the leading mathematics departments of the country, the lineage of many new recruits can be traced back to the MTTS Programme.

So too, when the participants return to their home institution after the Programme, their teachers are impressed with the radical changes in the student's attitude towards mathematics and their problem solving skills. The teachers evince a keen interest in learning and adopting the teaching methodology of the programme. To attend to these requests and also to reach a large number of students across the country, we have recently begun conducting the PTMT programme, as mentioned earlier.

MTTS has also helped improve and sharpen teaching skills of many of the MTTS faculty members.

Other science disciplines, especially Physics, have shown interest to start programmes embracing the principles of MTTS.

Many students after attending just one level of MTTS get selected for the Visiting Students' Research Programme (VSRP) of leading research institutions, in the country. This just shows the confidence that these institutes reflect as regards MTTS training.

The largest alumni group in the International Congress of Mathematicians (ICM) 2010 was possibly that of the participants and faculty members of MTTS Programmes. This speaks volumes about the contribution of this programme to Mathematics in India.

#### References:

MTTS Website: <http://www.mtts.org.in/>

PTMT Website: <http://www.ptmt.mtts.org.in/>

NBHM Website: <http://www.nbhm.dae.gov.in/>

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Believe nothing,  
Merely because you have been told it.  
Or because it is traditional.  
Or because you yourself have imagined it.  
Do not believe what your teacher tells you,  
Merely out of respect for the teacher.  
But whatever, after due examination  
and analysis,  
You find to be conducive to the good,  
The benefit, the welfare of all beings,  
That doctrine believe and cling to,  
And take it as your guide.

*---Gautam Buddha*