Chennai Mathematical Institute

Annual Report

2004–2005

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Preface

The School of Mathematics was created in 1989 as a Division of the SPIC Science Foundation with the aim of building a centre of excellence in Mathematical Sciences. In August 1996, it became an independent institution called the SPIC Mathematical Institute (SMI), managed by a Trust of the same name, through a Governing Council. In order to place the Institute in a larger public domain, the name of the Institute was changed to Chennai Mathematical Institute (CMI) in January 1999.

During the first phase, the goal had been to establish strong research programmes in Mathematics, Computer Science and related subjects.

Algebraic geometry, representation theory, differential geometry, commutative algebra and topology are the areas that are currently being pursued in Mathematics. In Computer Science, research is being pursued in the areas of formal specification and verification, the theory of timed and hybrid systems, the design and analysis of algorithms and computational complexity. Other areas of interest include control theory, partial differential equations and mechanics.

A major component of the Institute is its Ph.D. programme. CMI has evolved a joint Ph.D. programme with the Birla Institute of Technology and Science, Pilani. The Ph.D. programme at CMI is also recognized by the University of Madras.

In August 1998, a new dimension was added to the activities of CMI with the start of the National Undergraduate Programme in Mathematics and Computer Science (B.Sc. Hons.) where talented students, selected at the national level, are taught by experts who have contributed to these fields. We have the continued support of scientists from other institutions, especially the Institute of Mathematical Sciences (IMSc.), Chennai, the Tata Institute of Fundamental Research (TIFR), Mumbai, the Indian Institute of Technology (IIT), Chennai, Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Homi Bhabha Centre for Science Education (HBCSE), Mumbai and

Institute for Financial Management and Research, Chennai (IFMR). Substantial support for this initiative is being provided by the National Board for Higher Mathematics (NBHM), an autonomous body constituted and funded by the Department of Atomic Energy (DAE). The programme is also supported by the Indian Space Research Organisation (ISRO).

This programme has turned out to be highly successful. Four batches have already graduated and found placements in some of the best institutions in the world. From 2003, CMI has added a Physics component to this programme with Prof. G. Rajasekaran, a distinguished physicist, in charge. A number of distinguished physicists from all over the country, especially from the Institute of Mathematical Sciences, Chennai, are a part of the teaching faculty for this programme as well. After completing this programme, the degree of B.Sc. (Hons.) Physics will be awarded to the students.

In 2001, the teaching programme at CMI was extended to include separate 2-year M.Sc. courses in Mathematics and Computer Science. The present strength of the students in the B.Sc., M.Sc. and Ph.D. is seventy-six.

Since its inception, the Chennai Mathematical Institute has had an active group of researchers in the fields of pure mathematics and theoretical computer science. Over the years it has made very substantial contributions in these areas which is evidenced by the important research papers as well by the number and quality of doctoral students who are placed in various centres in India and abroad. The research activity is also enhanced and supported by seminars and lectures both by the faculty and the students of CMI as well as through a healthy inflow of visitors from other research centres in India and abroad. The seminars are the life-line of any research group and we have had a rich tradition in this which continues with greater force since the graduation of some very bright young students from the National Undergraduate Programme at CMI. We are very gratified to note that some of these young students have shown great potential and initiative and have the potential to create the next generation of researchers in India. Many of these students have now

gone abroad to some of the prestigious centres the world over and it is our firm belief that many of these would eventually return as faculty members.

Members of the Faculty have strong academic ties with reputed research institutions in India and abroad. The Institute participates in a programme of the Third World Academy of Sciences (TWAS), Trieste, Italy called the "Associate Membership Scheme at Centres of Excellence in the South". CMI has also entered into a Memorandum of Understanding with the Indian Statistical Institute (with centres at Calcutta, Delhi and Bangalore) to undertake collaboration in research, teaching and extension activities in the subject of Mathematical Sciences.

The Institute has a memorandum of understanding with the École Normal Supérieure in Paris, France, one of the leading institutions in the world for teaching and research in Mathematics. This agreement provides for regular exchange visits by academic members of CMI and ENS, Paris including, in particular, exchanges of visits by undergraduate students between the two institutions. Since 2000–2001, there have been regular visits from both sides each year under this programme.

CMI has entered into a Memorandum of Understanding with the Institute for Financial Management and Research (IFMR) in connection with IFMR's new one-year programme in Financial Mathematics. Faculty from CMI teach some courses in this programme and will also potentially participate in joint research.

The faculty at CMI participate in collaborative research projects with research groups from both academic and commercial organizations. CMI has had two sponsored research projects with Honeywell Technology Solutions Laboratory, Bangalore, during the period 2004–2005, both in the area of formal verification.

The Institute actively supports conferences and workshops and other activities that contribute to the growth of Mathematics and Computer Science in the country.

A major initiative that has begun during 2004–2005 is the construction

of the new Institute campus at the SIPCOT Information Technology Park, Siruseri, on the southern outskirts of the city. The foundation stone for the campus was laid in August, 2004 and the first phase is expected to be completed during the academic year 2005–2006. The funds for the campus have come from private sources, with major contributions from Matrix Laboratories, Hyderabad and the Shriram Group Companies, Chennai.

C S SESHADRI
Director

Academic Members

C.S. Seshadri (Director)
Shiva Shankar (Professor)

S. Dale Cutkosky (Adjunct Professor)
V. Kumar Murty (Adjunct Professor)
V. Lakshmibai (Adjunct Professor)
K.R. Nagarajan (Fr. Racine Visiting Professor)
R. Parimala (Adjunct Professor)
G. Rajasekaran (Adjunct Professor)
S. Ramanan (Adjunct Professor)
M. Ram Murty (Adjunct Professor)
Rani Siromoney (Adjunct Professor)
R. Sridharan (Adjunct Professor)
Tulsi Dass (Visiting Professor)

V. Balaji (Associate Professor)
Madhavan Mukund (Associate Professor)

C.S. Aravinda (Reader)
K. Narayan Kumar (Reader)
S. Senthamarai Kannan (Reader)
K.V. Subrahmanyam (Reader)

Bharat Adsul (Fellow)
Clare D' Cruz (Fellow)
M.K. Vemuri (Fellow)
Suresh Nayak (Fellow)
S.P. Suresh (Fellow)
Matthias Meulien (Visiting Fellow) (until December 2004)

P. Vanchinathan (Scientific Officer)

Anindya Mozumdar (Research Scholar)
A. Baskar (CSIR Research Scholar)
Debajyoti Nandi (Research Scholar) – (until July 2004)
S. Jijo (CSIR Research Scholar)
K. Paramasamy (Research Scholar) – (until January 2005)
R. Parthasarathi (NBHM Research Scholar)
C. Prakash (Research Scholar)
Pranab Sardar (Research Scholar)
Puneet Bhateja (Research Scholar)
Rishi Raj (Research Scholar)
Saket Saurabh (Research Scholar) – (until July 2004)
T. Saravanan (Research Scholar)
Shyamasri Upadhyay (NBHM Research Scholar)
Suman Bandyopadhyay (Research Scholar)

Administrative Staff

S. Sripathy
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G. Samson

Faculty Profiles

C.S. Seshadri

C.S. Seshadri received his B.A. Hons. (Mathematics) degree from Madras University (1953) and his Ph.D. from Bombay University (1958).

He was at the School of Mathematics, Tata Institute of Fundamental Research, Bombay from 1953 to 1984 starting as a Research Scholar and rising to a Senior Professor. He was then a Senior Professor at the Institute of Mathematical Sciences, Madras (1984–89).

He has been a Visiting Professor at the University of Paris, France; Harvard University, Cambridge, U.S.A.; Institute for Advanced Study, Princeton, U.S.A.; University of California at Los Angeles, Los Angeles, U.S.A.; Brandeis University, U.S.A.; University of Bonn, Bonn, Germany; Kyoto University, Kyoto, Japan.

He has given invited talks at many international conferences including the International Congress of Mathematicians, Nice, France, 1970.

He has received the Shanti Swarup Bhatnagar Award and the Srinivasa Ramanujan Medal of Indian National Science Academy (INSA). He was awarded the D.Sc. Degree (Honoris Causa) of Banaras Hindu University, Varanasi. He has also been awarded the Shanti Swarup Bhatnagar Medal (1995) of INSA.

He is a Fellow of the Indian Academy of Sciences, Indian National Science Academy and a Fellow of the Royal Society.

His research interests are: Algebraic Geometry and Algebraic Groups.

Shiva Shankar

Shiva Shankar received his B.Tech. (Electrical Engineering) from the Indian Institute of Technology, Delhi (1978) and his Ph.D. from

SUNY, Stony Brook (1983).

He has been an Assistant Professor, at the Department of Applied Mathematics, SUNY, Stony Brook (1983–84), a Visiting Fellow at the School of Mathematics, Tata Institute of Fundamental Research, Bangalore (1984–88), an Associate Professor at the Department of Electrical Engineering, Indian Institute of Technology, Bombay (1988–2000).

Visiting Positions include Institute of Mathematical Sciences, Chennai, and at Mathematics Institute, University of Groningen.

His research interests are: Partial Differential Equations, Mechanics and Control Theory.

K.R. Nagarajan

K.R. Nagarajan received his B.Sc. (Mathematics) Hons. degree from Annamalai University (1953), his M.S. (Mathematics) from University of Chicago (1958) and his Ph.D. (Mathematics) from University of Chicago (1962).

He has been a Lecturer at the Kerala University, Kerala (1965–67), a Reader at the Madurai Kamaraj University, Madurai (1967–76), a Professor and the Head of School of Mathematics, Madurai Kamaraj University (1976–78–93) and a Visiting Professor, Central University, Pondicherry (1995–96).

His research interest is: Commutative Algebra - Invariants.

Rani Siromoney

Rani Siromoney received her B.A. (Hons.) (Mathematics) degree from Madras University (1950), Master's degree from Columbia University (1960) and Ph.D. from Madras University (1970).

She has been associated with the Madras Christian College since 1951, starting as a Lecturer and is now Professor Emeritus in the Department of Computer Science.

She has been a Visiting Professor at the Boston University (1974) and Visiting Scientist at the IIAS – Fujitsu Laboratories Numazu, Japan (1991).

She has given invited talks in Theoretical Computer Science at many national and international conferences and lectures at several universities and Research Institutes.

She has been awarded the Smith Mundt/Fulbright Scholarship for study in Columbia University (1958-59), "Outstanding Woman Professional" by the Federation of Industries and Chamber of Commerce (India) Ladies Organization, New Delhi (1984-85) and "Lifetime Achievement Award" by the Tamil Nadu State Council of Science and Technology (2002).

Her research interests are: Formal languages and Automata, Picture languages, Cryptography, Machine learning and DNA Computation.

R. Sridharan

R. Sridharan received his B.A. (Mathematics) degree from Vivekananda College, Chennai (1952), his M.A. (Mathematics) from Vivekananda College, Chennai (1955) and his Ph.D. (Mathematics) from Columbia University, New York (1960).

He has been a Professor at the University of Bombay, Mumbai (1964–67) and a Senior Professor at the Tata Institute of Fundamental Research, Mumbai (1967–2000).

He is a Fellow of the Indian Academy of Sciences and Indian National Science Academy.

He received the Shanti Swarup Bhatnagar Prize of the Indian National Science Academy (1980).

He has been an INSA Honorary Scientist since January 2001.

His research interest is: Algebra.

V. Balaji

V. Balaji received his B.A. Hons. (Mathematics) from University of Delhi (1982), his M.A. (Mathematics) degree from University of Delhi (1984), his Ph.D. from University of Madras (1991).

He has been an NBHM Post-doctoral Fellow at the Chennai Mathematical Institute (1989–92).

His research interest is: Algebraic Geometry.

Madhavan Mukund

Madhavan Mukund received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1986) and his Ph.D. from Aarhus University, Aarhus, Denmark (1992).

He is a member of the Executive Council and the Secretary of the Indian Association for Research in Computing Science (IARCS).

His research interests are: Partial order based models for concurrent systems and Logics for specifying and verifying concurrent systems.

C.S. Aravinda

C.S. Aravinda received his B.Sc. degree from Bangalore University (1983), his M.Sc. (Mathematics) degree from Bangalore University (1985) and his Ph.D. from the University of Bombay (1995).

He has been a Visiting Mathematician at ICTP, Trieste, Italy (1991–92) and a Research Associate at the Indian Statistical Institute, Bangalore (1995–97).

He has been a visiting Associate Professor at the State University of New York at Binghamton (2000-2002).

His research interests are: Ergodic Theory, Riemannian Geometry and Topology.

K. Narayan Kumar

K. Narayan Kumar received his M.Sc. (Tech.) in Computer Science

from Birla Institute of Technology and Science, Pilani (1990). He received his Ph.D. degree from the University of Bombay (1997). He has been a visiting scholar at the State University of New York at Stony Brook (1997–98).

His research interests include Logic, Automata theory and Concurrency.

S. Senthamarai Kannan

S. Senthamarai Kannan received his B.Sc. degree from HKRH College, Uthama Palayam (1985–88), M.Sc. degree from the Madurai Kamaraj University (1988–90) and Ph.D. from the Chennai Mathematical Institute, (1992–98). He has been a Post-doctoral Fellow at the International Centre for Theoretical Physics (1999–2000).

His research interests are: Representation Theory and Algebraic Geometry.

K.V. Subrahmanyam

K.V. Subrahmanyam received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1986) and M.S. from Vanderbilt University, U.S.A. in 1987. He received his Ph.D. degree from the University of Bombay in December, 1995.

His research interests are: Circuit Complexity, Algebraic methods in Complexity theory.

Clare D' Cruz

Clare D' Cruz received her M.Sc. (Mathematics) from the Indian Institute of Technology, Bombay (1991) and her Ph.D. (Mathematics) from the Indian Institute of Technology, Bombay (1996).

She has been a Post-Doctoral Fellow at the Tata Institute of Fundamental Research, Mumbai (1996–98) and a Visiting Scholar at the Northeastern University, Boston, U.S.A. (1997–98).

Her research interest is: Commutative algebra.

M.K. Vemuri

M.K. Vemuri received his M.S. (Mathematics) from Syracuse University, U.S.A. (1989) and Ph.D. from the University of Chicago, U.S.A. (1997).

He has been a Visiting Assistant Professor at Colgate University, U.S.A. (1997–99), an Instructor at Polytechnic University, U.S.A. (1999–2000) and a Teaching Research Associate at Syracuse University, U.S.A. (2000–2002).

His research interest is: Analysis

Bharat Adsul

Bharat Adsul received his B.Tech. (Computer Sc. and Engg.) degree from the Indian Institute of Technology, Bombay (1997) and Ph.D. (Computer Sc. and Engg.) degree from the Indian Institute of Technology Bombay (2003).

His research interests are: Logic, Concurrency and Combinatorics.

Suresh Nayak

Suresh Nayak received his B.Tech. (Computer Science) degree from the Indian Institute of Technology, Bombay (1991), M.S. and Ph.D. (Mathematics) degree from the Purdue University, (1997,98).

He has been a Visiting Fellow at the Harish-Chandra Research Institute, Allahabad (1999–2001).

His research interests are: Algebraic Geometry and Commutative Algebra.

S.P. Suresh

S.P. Suresh received his M.C.A. degree from R.E.C. Trichy (1996), received his M.Sc. (by Research) from Anna University (1999) and received his Ph.D. degree from the Institute of Mathematical Sciences

(2003).

His research interests are: Logic in Computer Science, Reasoning about Security protocols and Classical Indian Epistemology.

Research Activities

Mathematics

The research activity in Mathematics in CMI has been primarily in the fields of Algebraic Geometry, Algebra, Differential geometry and Partial Differential Equations, Representation theory and History of Mathematics.

In the field of Algebraic Groups and representation theory, the study of the cohomology of line bundles given by non-dominant weights on Schubert varieties was extended to the case of Schubert varieties in the flag variety associated to the Kac-Moody group. The precise bounds for the top and least indices of the non-vanishing cohomology modules have been given. A cohomological criterion for the Bruhat order has been studied. Cyclicity (as a B- module, B being the Borel subgroup of the Kac-Moody group) of the top non-vanishing cohomology module has been obtained. This carries forward some earlier work done here in the finite dimensional setup to the Kac-Moody setting.

In the field of Commutative Algebra, the behaviour of the Castelnuovo-Mumford regularity was the main theme of study. It has been of importance to construct examples of curves with large regularity and this has been done.

In the field of Differential Geometry, it was shown that there exist closed Riemannian manifolds M all of whose sectional curvatures are negative, but M does not admit any metric with nonpositive curvature operator; this answers a question raised by P. Petersen in his textbook on Riemannian Geometry.

As a part of research activity in the field of History of Mathematics, it was proved that the construction of Kummer (work in the mid 19th Century) of an infinity of rational quadrilaterals with rational diagonals breaks down if one drops an essential condition assumed tacitly by Kummer. This phenomenon is equivalent to showing that an elliptic curve given as an intersection of a pair of quadrics has no integral rational point. In a very particular case, this is equivalent to

the non-existence of four rational squares in arithmetic progression. This goes back to some problems studied already by the Greeks.

An on-going project is the study of the question as to when the left and the right adjoints of a functor are naturally isomorphic. In a very special case this study leads to the consideration of the so-called Frobenius algebras which contain a special case group rings of finite groups.

In the field of Algebraic geometry one of the main areas of interest in the institute is in the field of Duality Theory. An abstract criterion for pasting pseudofunctors was defined over two subcategories of a given category into one over the whole category. This has applications in Grothendieck duality theory.

The study of bundles and sheaves on algebraic curves has been one of the central areas of research in mathematics in the last five decades and the Indian contribution in this are has been fundamental. The work of M.S.Narasimhan and C.S.Seshadri and others from the Tata school played a key role in the subsequent work in the geometry of 4 manifolds arising from the work of Atiyah, Donaldson, Witten and others. In this work, which involves a deep interplay between topology and algebraic geometry, it has been an important issue to be able to study topological invariants arising out of the geometry of moduli spaces of bundles on surfaces. Some of the questions that remained unanswered in this area were related to moduli problems of principal bundles on higher dimensional varieties. There has been some contribution to this problem and the foundational work of setting up and solving the existence problem and projectivity of these moduli spaces has been carried out. In an on-going project, the related study of parabolic bundles on surfaces has also been taken up. This is also closely related to the fundamental work of Kronheimer and Mrowka on extensions of Donaldson theory for embedded manifolds.

K Paramasamy has submitted his Ph.D. thesis entitled *Cohomology of line bundles on Schubert varieties* to the University of Madras. He is expected to receive his degree by August, 2005.

Computer Science

The research activity in Computer Science at CMI has been primarily in the fields of logic programming, specification and verification of distributed systems, analysis of security protocols and DNA computing.

In the area of logic programming, a general framework has been proposed for constructing fold-unfold program transformation systems for definite logic programs. It has been shown that any system developed in this manner is provably correct and that all existing fold-unfold systems can be obtained as instances of this general framework, thereby obtaining a single correctness proof for all these systems. The new framework is also used to develop a system that subsumes every existing system in expressive power.

In the area of distributed systems, aperiodic distributed behaviours have been characterized in terms of a natural cascade product of the gossip automaton with a counter-free distributed automaton. The characterization strengthens the fundamental results of Schutzenberger and, McNaughton and Papert and implies that star-free, equivalently, first-order-definable trace languages admit counter-free distributed acceptors modulo the gossip automaton.

Message sequence charts (MSCs) are a visual notation for specifying the behaviour of communicating agents. A new notion of concatenation for MSCs called anchored concatenation has been developed, which lies between the traditional extremes of synchronous and asynchronous concatenation. When High-Level Message Sequence Charts (HMSCs) are interpreted using anchored concatenation, checking for the existence of implied scenarious is decidable. Separately, a new notion of realizability, called causal realizability, has been defined for MSC languages. This notion strengthens the notion of weak realizability in the literature. Importantly, checking causal realizability is decidable for regular MSC languages, whereas checking weak realizability is known to be undecidable for this class.

In the areas of security protocol verification, decidability issues have been examined. In general, verifying properties of security

protocols is undecidable. To tackle this problem, syntactic subclasses of protocols have been identified, whose structure ensures that the verification of secrecy is equivalent to verifying a finite state system for secrecy, and hence decidable. Some techniques have been developed for handling unbounded number of keys and nonces. These results have also been extended to decide not just secrecy properties, but any property specified in a general logic which also includes knowledge modalities. Separately, a generic methodology has been proposed for verifying secrecy properties using the automated model-checking tool Spin. This approach also establishes that a weaker intruder model than the traditional Dolev-Yao model suffices to verify secrecy properties.

In DNA computing, an algorithm of Tom Head based on Circular DNA to solve 3-SAT has been adapted to break a cryptosystem based on propositional logic introduced by J. Kari.

Publications

I Journal Articles

Mathematics

[J1] C.S. Aravinda and F.T. Farrell: Nonpositivity: Curvature vs Curvature operator, *Proc. of AMS*, Vol. 133, No. 1 (2004).

[J2] V. Balaji, I. Biswas and D.S. Nagaraj: Krull-Schmidt Theorem for principal bundles, *J.reine.angew.Math*, 578 (2005), 225–234.

[J3] V. Balaji, I. Biswas, D.S. Nagaraj and P.E. Newstead: Universal Families on moduli of principal bundles, to appear in *International Math Research Notices*).

[J4] V. Balaji, I. Biswas and D.S. Nagaraj: Tannakian Krull-Schmidt Theorem, to appear in *J. reine. angew. Math.*

[J5] Clare D'Cruz: The integral closedness of MI and the formula of Hoskin and Deligne for finitely supported ideals, to appear in *J. Algebra.*

[J6] Clare D'Cruz, J. Verma and V. Kodiyalam: Bounds on the a-invariant and reduction numbers of ideals, *J. Algebra*, 274 (2004), no. 2, 594–601.

[J7] J. Lipman, P. Sastry and Suresh Nayak: Pseuofunctorial behavior of Cousin complexes on formal schemes, pages 3–133 in Variance and duality for Cousin complexes on formal schemes, *Contemporary Math* Vol. 375, American Math. Soc. (2005)

[J8] R. Sridharan and K.R. Nagarajan: Brahmagupta's and Kummer's Quadrilaterals, to appear in *Elemente der Mathematik.*

[J9] Suresh Nayak: Pasting pseudofunctors, pages 195–271 in Variance and duality for Cousin complexes on formal schemes, *Contemporary Math* Vol. 375, American Math. Soc. (2005)

[J10] M.K. Vemuri and Tim Steger: Inductive algebras for $SL(2, R)$, accepted for publication in the *Illinois J. Math.*

Computer Science

[J11] Abhik Roychoudhury, K. Narayan Kumar, C.R. Ramakrishnan and I.V.Ramakrishnan: An unfold/fold transformation framework for definite logic programs, *ACM Trans. Program. Lang. Syst.* 26 (3), 464–509 (2004).

[J12] R. Ramanujam and S.P. Suresh: Decidability of context-explicit security protocols, to appear in *Journal of Computer Security.*

II Conference Papers

Mathematics

[C1] R. Sridharan: Sanskrit Prosody, Pingala Sutras and Binary Arithmetic, to appear in the Proceedings of the Colloquium based on the *AMS-India joint session* on "Ancient Indian Mathematics".

[C2] R. Sridharan: Mathematics in ancient and mediaeval India (based on a lecture given at the Nehru Centre, Mumbai), to appear in the Proceedings of the Colloquium based on the *AMS-India joint session* on "Ancient Indian Mathematics".

Computer Science

[C3] Bharat G. Adsul: Asynchronous-Automata for Aperiodic Trace Languages, *Proc. FSTTCS 2004*, Lecture Notes in Computer Science **3328**, Springer (2004), 84–96.

[C4] Rani Siromoney and Bireswar Das: Circular DNA Based Algorithms to Solve Hard Problems, Special volume of papers presented at the *AMS Meeting*, Seville, Spain, June 2003, RSME/AMS (2004).

[C5] Rani Siromoney and Bireswar Das: Plasmids to solve #3SAT, *Aspects of Molecular Computing, Essays Dedicated to Tom Head on the occasion of his 70th birthday*, Lecture Notes in Computer Science **2950**, Springer (2004) 361–366.

III Preprints and Reports

Mathematics

[P1] V. Balaji: Principal bundles on projective varieties and the Donaldson-Uhlenbeck compactification (*math AG/0505106*).

[P2] V. Balaji, A. Dey and R. Parthasarathi: Geometry of bundles with parabolic structures on surfaces (*math AG/0601274*).

[P3] Clare D'Cruz: On the Rees algebra and fiber cone of ideals.

[P4] P. Sastry and Suresh Nayak: Applications of duality theory to Cousin complexes

[P5] S. Senthamrai Kannan: Cohomology of line bundles on Schubert Varieties in the Kac-Moody setting.

[P6] C.S. Seshadri: Geometric reductivity (Mumford's Conjecture) – revisited.

Computer Science

[P7] Bharat Adsul, Madhavan Mukund, K. Narayan Kumar and V. Narayanan: Causal closure for MSC languages (To be presented at *FSTTCS 2005*).

[P8] Prakash Chandrasekaran and Madhavan Mukund: Automated Verification of Communicating Systems.

[P9] Abdul Sahid Khan, Madhavan Mukund and S.P. Suresh: Generic Verification of Security Protocols (To be presented at *SPIN 2005*).

[P10] Madhavan Mukund, K. Narayan Kumar, P.S. Thiagarajan and Shaofa Yang: Anchored Concatenation of MSCs.

[P11] Rani Siromoney: On Solutions to Challenging problems that made NEWS , Special volume published by MCC, Department of mathematics.

Physics

[P12] Tulsi Dass: Histories Approach to Quantum Mechanics, CMI/PHYS-2005-1, arxiv : quant-ph/0501161.

Conferences, Visits and External Lectures

C.S. Seshadri

- Attended the 2-day workshop organised jointly by CMI and NSOU (Netaji Subash Open University) in Kolkata during October, 2004.
- Gave the Srinivasa Rajan Memorial Endowment Lecture at the Ramanujan Institute for Advanced Study in Mathematics, Chennai, in January 2005.

Shiva Shankar

- Gave an invited (plenary) talk on "Controllability for Systems of PDE" at the MTNS, Leuven, Belgium in July 2004.
- Visited INRIA, Sophia Antipolis, under a French Government scholarship during Novemeber–December, 2004 and gave a lecture on "A Cousin Problem for Systems of PDE".
- Associate Editor, International Journal on Multidimensional Systems and Signal Processing (Kluwer).

Rani Siromoney

- Gave a Special Seminar on "Forty years of Formal Language Theory" at MCC, in July 2004.
- Gave a talk on "DNA-based solutions to hard problems - Graph Theoretic and others" (UGC sponsored State leval Seminar on Graph Theory and Applications) at Lady Doak College, Madurai, during August 2004.
- Gave Father Racine Memorial Endowment Lecture on "Kambi Kolam and Circular DNA Splicing", at Loyola College, Chennai.

- Gave a talk on "Context Free Languages" at the Workshop on Some Harder Problems on Theory of Computation, in June, 2004, at Misrimal Navajee Munoth Jain Engineering College, Chennai.

- Gave a series of 5 lectures on "Primes is in P", "DNA Splicing", "Circular DNA and NP Hard Problems", "Cryptography, network security, information security" and "Public Key Cryptosystems" at the Refresher Course for faculty in colleges, organized by the Academic Staff College, University of Madras, Chennai.

- Gave lectures at the Ph.D. School in Formal languages and Automata, at the University of Rovri Virgili, Tarragona, Spain.

- Gave a Series of about 20 lectures to the M.Phil students in the Department of Computer science, University of Madras on "Theory of Compuutation" and "Bio Informatics".

K.R. Nagarajan

- Gave two lectures on "Valuations and Adeles" at St. Joseph College, Irinjalakuda, organized by the Kerala Mathematical Society in September 2004.

R. Sridharan

- Gave two lectures on "Algebra and Number Theory" at the University of Calicut, Calicut, in August 2004.

- Gave two lectures on "Riemann Roch Theorem" at St. Joseph College, Irinjalakuda, organized by the Kerala Mathematical Society in September 2004.

- Gave a talk in the 2-day workshop organised jointly by CMI and NSOU (Netaji Subash Open University) in Kolkata during October, 2004.

- Gave a talk in the National Seminar on "Algebra, Analysis and Discrete Mathematics" at the University of Kerala, Thiruvananthapuram, in January 2005.

Tulsi Dass

- Gave an invited talk on "Understanding quantum mechanics" in the Institute of Mathematical Sciences, Chennai in August 2004.
- Attended the Nineth Frontier Meeting (organised by the Meera Memorial Trust) at Centre for Learning at Vardanahalli (near Bangalore) and gave two lectures on "Histories approach to quantum mechanics" and "Measurements and Decoherence" during January 2005.
- Gave about 10 lectures on "Foundations of quantum mechanics" as part of the course Quantum Mechanics II (Instructor: G. Rajasekharan) to B.Sc. IInd year students in 2004–05, second semester.
- Book writing

  Changed the tentative title of the book titled 'Noncommutative geometry and physics' to 'Foundations of Geometry, Probability and Physics'.

Madhavan Mukund

- Attended IFCPAR Indo-French Seminar on Information Technology, in Pune and gave an invited talk on "Netcharts: Bridging the gap between HMSCs and executable specifications" in December 2004.
- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004 and chaired a session.
- Attended Tata Excellence in Computer Science Week 2005 on "Security Modelling", at Tata Research Development and Design Centre, Pune, in January 2005.
- Member, Editorial Board, Formal Methods Letters.
- Member, Program Committee, 26th International Conference on Theory and Application of Petri Nets (ICTAPN) 2005, Miami, Florida.
- Secretary, Indian Association for Research in Computing Science (IARCS).
- National Coordinator, Indian National Olympiad in Informatics.
- Team Leader of the Indian team, International Olympiad for Informatics, Athens, Greece, September 2004.
- Column editor, "News from India", Bulletin of the European Association for Theoretical Computer Science (EATCS).

C.S. Aravinda

- Participated in the conference on 'Low-dimensional topology' in ISI, Bangalore during June 2004 and gave a set of 3 lectures on "Negative curvature in Geometry".

- Attended the 2-day workshop organised jointly by CMI and NSOU (Netaji Subash Open University) in Kolkata during October, 2004 and gave a lecture on "Classifying low-dimensional manifolds".

- Visited the Indian Statistical Institute, Kolkata and gave a colloquium talk "Rigidity in nonpositive curvature and exotic structures" in October 2004.

- Visited the Tata Institute of Fundamental Research, Mumbai during February-March 2005 and gave three lectures on "Ricci flow and geometrization" in their Current topics seminar.

- Gave an invited colloquium talk on "Rigidity in nonpositive curvature and exotic structures" at the Indian Institute of Technology, Mumbai in March 2005.

- Local co-ordinator for conducting the annual KVPY exams at the Chennai centre in November, 2004.

K. Narayan Kumar

- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004.

- Attended Tata Excellence in Computer Science Week 2005 on "Security Modelling", at Tata Research Development and Design Centre, Pune, in January 2005.

- Member of the Program Committee for the 24th conference on the Foundations of Software Technology and Theoretical Computer Science (FSTTCS04) held at Chennai.

- Coach at the training camp for selecting the Indian team to participate in the International Informatics Olympiad at Athens, Greece.

- Deputy Leader of the Indian team to the International Informatics Olympiad held at Athens, Greece in September 2004.

K.V. Subrahmanyam

- Attended the workshop on "Algorithms" organized in October 2004 at the Indian Institute of Science, Bangalore.
- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004.
- Gave a survey talk at the Institute of Mathematical Sciences on "Smoothed analysis".

Clare D' Cruz

- Attended the School on "Commutative algebra and its interactions with algebraic geometry and combinatorics" held at International Centre for Theoretical Physics, Trieste, Italy and gave an invited talk on "The integral closedness of MI and the formula of Hoskin and Deligne for finitely supported ideals", during May-June 2004.
- Visited the Indian Statistical Institute, Bangalore and gave a talk on "Introduction to Castelnuovo-Mumford regularity" in January 2005.
- Visited the Indian Institute of Technology, Bombay and gave a talk on "Castelnuovo-Mumford regularity of powers of ideals and its radical" in February 2005.

M.K. Vemuri

- Attended conference on Topology at the Indian Statistical Institute, Bangalore.
- Gave a lecture on "Can one hear the shape of a drum?" at Netaji Subhash Open University, Kolkata, in October 2004.
- Attended AMS meeting held at Atlanta, U.S.A. in January 2005.
- Visited the Tata Institute of Fundamental Research, Mumbai, in March 2005.
- Gave a talk on "A minimal introduction to Kahler geometry", at the Institute of Mathematical Sciences, Chennai, in March 2005.
- Attended the Course on "Non commutative measure theory" by V. S. Sunder at the Institute of Mathematical Sciences during January–March 2005

Bharat Adsul

- Visited Prof. Milind Sohoni at the Institute of Technology, Bombay, in June 2004.
- Gave a talk on "Cascade Products of Distributed Automata" at the Institute of Mathematical Sciences, in November 2004.
- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004 and gave a talk on "Asynchronous-Automata for Aperiodic Trace Languages".

S.P. Suresh

- Attended the annual meeting of the Calcutta Logic Circle at the Calcutta University and gave an invited talk on "Pramanya" in October 2004.

- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004.

- Attended Tata Excellence in Computer Science Week 2005 on "Security Modelling", at Tata Research Development and Design Centre, Pune, in January 2005.

- Attended the First Indian Conference on *Logic and Its Relationship with Other Disciplines* at the Indian Institute of Technology, Bombay and gave an invited talk on "Pramanya" during January 2005.

- Attended the CIMPA-UNESCO-INDIA School on *Security for Computer Systems and Network* at the Indian Institute of Science, Bangalore and gave an invited talk titled "Decidability of Secrecy for Security Protocols" during January–February 2005.

A. Baskar

- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004.

- Attended the International Conference on Distributed Computing & Internet Technology held at KIIT, Bhubaneswar during December 2004.

- Attended Tata Excellence in Computer Science Week 2005 on "Security Modelling", at Tata Research Development and Design Centre, Pune, in January 2005.

- Attended the First Indian Conference on *Logic and Its Relationship with Other Disciplines* at the Indian Institute of Technology, Bombay during January 2005.

C. Prakash

- Attended the 24th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2004) at the Institute of Mathematical Sciences, Chennai, in December 2004.

- Attended the International Conference on "Distributed Computing & Internet Technology" held at KIIT, Bhubaneswar during December 2004.

- Attended Tata Excellence in Computer Science Week 2005 on "Security Modelling", at Tata Research Development and Design Centre, Pune, in January 2005.

- Attended the First Indian Conference on *Logic and Its Relationship with Other Disciplines* at the Indian Institute of Technology, Bombay during January 2005.

- Attended CIMPA School on *Security of Computer Systems and Networks* held at Indian Institute of Science, Bangalore during January-February 2005.

Symposium

CMI organized a one-day Symposium to celebrate Prof. V. Lakshmibai's 60th birthday in January 2005. The following people gave invited lectures in the symposium.

- Prof. C.S. Seshadri gave the Inaugural talk.
- Prof. V.B. Mehta, Tata Institute of Fundamental Research, Mumbai, gave a talk on "Closed points of the moduli space of principal bundles on curves (joint work with S. Subramaniam)".
- Dr. K.N. Raghavan, Institute of Mathematical Sciences, Chennai, gave a talk on "Towards an equivariant Schubert calculus (joint work in progress with V. Lakshmibai and P. Sankaran)".
- Prof. A.J. Parameswaran, Tata Institute of Fundamental Research, Mumbai, gave a talk on "Virtual global generation of ample bundles".
- Dr. V. Trivedi, Tata Institute of Fundamental Research, Mumbai, gave an invited talk.
- Dr. S. Senthamarai Kannan gave a talk on "On Characters of cohomology modules of line bundles on Schubert Varieties (joint work in progress with K.V. Subrahmanyam)".
- Prof C. Musili, University of Hyderabad, Hyderabad, gave the Concluding talk.

Courses, Special Lectures

Prof. G. Rajasekaran, Institute of Mathematical Sciences, Chennai. Gave talks on "Physics at the turn of the century", "Classical Physics", "Relativity and Quantum Physics A pedagogical overview of the basic concepts" and "Is there a Final Theory?" (October 2004).

Dr. Matthias Meulien. Gave CMI-IMSc Representation Theory Seminar on "Compactification of Thin Schubert cells (after L. Lafforgue)" (November 2004).

Rishi Raj. Gave CMI-IMSc Representation Theory Seminar on "Character formulas and localization of integrals" (December 2004).

Midweek Colloquium Series

As part of an effort to bring the students in the National Undergraduate Programme closer to the research activities of the Institute, a regular colloquium series was organized, roughly on a weekly basis, starting in January, 2000. The talks in this series during 2004-05 were as follows:

Prof. R Sridharan: "Eudoxus, Euclid and Real Numbers" (April 2004).

Marc Wouts, ENS, France: "An introduction to the study of phase coexistence in the Ising model" (August 2004).

Alexis Saurin, ENS, France: "An introduction to mathematical logic" (September 2004).

Institute Colloquium Series

Adrien Deloro, ENS Lyon: "An introduction to mathematical logic" (September 2004).

Ideas for All – A Popular Lecture Series on diverse themes of human endeavour and knowledge

CMI has initiated the above lecture series, not only for the students of the institute but also for the larger public. This year two talks were organized in this lecture series.

Mr. S. Theodore Baskaran, Film Historian, Nature Writer: "The Cultural Context of the emergence of star Politicians in South India" (September 2004).

Prof. Anindya "Rana" Sinha, National Institute of Advanced Studies, Bangalore, Indian Association for the Cultivation of Science, Kolkata: "How Monkeys See the World! The Search for an Animal Mind" (January 2005).

Visitors

Prof. M.S Raghunathan, Tata Institute of Fundamental Research, Mumbai. Gave talks on "The Grothendieck-Serre conjecture on rationally trivial principal bundles" and "Gauss-Bonnet theorem" (April 2004).

Dr. Krishnan Shankar, University of Oklahama, U.S.A. Gave a talk on "Spherical Rank Rigidity and Blashcke Manifolds" (June 2004).

Sourav Chakraborty, University of Chicago, U.S.A. Gave a talk on "On the sensitivity of Cyclically Invariant boolean functions" (August 2004).

Prof. Pasupathy, Indian Institute of Science, Bangalore. Gave two talks on "Quantum Computing and the Problem of Factorization of Integers" (November 2004).

Prof. M.P. Murthy, University of Chicago, U.S.A. Gave a talk on "Generators of a general ideal" (November 2004).

Prof. Leticia Brambila Paz, CIMAT, Mexico. Gave a talk on "Coherent systems and Brill-Noether theory" (December 2004).

Rahul Tripathi, University of Rochester, U.S.A. Gave a talk on "Understanding Relationships Between Quantum and Classical Complexity Classes: Separations, Collapses, and Closures" (December 2004).

Prof. A.P. Balachandran, Syracuse University, U.S.A. Gave a series of talks on "Classical Topology and Quantum Phases" (January 2005). .

Prof. Sara Billey, University of Washington, USA. Gave a talk on "Intersecting Schubert Varieties" (January 2005).

Prof. G. Harder, Director, Max Planck Institut fur Mathematik, Bonn, Germany. Gave a talk on "Galois Representations attached to Automorphic Forms" (February 2005).

Alexis Saurin, Ecole Polytechnique & INRIA Futurs. Gave a talk on "A neutral approach to proofs and refutation in the setting of proof search" (February 2005).

Prabhu Ramachandran, Department of Aerospace Engineering, Indian Institute of Technology Madras, Chennai. Gave a talk on "Vortex methods for 2D incompressible fluid flow simulations" (February 2005).

Prof. T.N. Shorey, Tata Institute of Fundamental Research, Mumbai. Gave a talk on "A Theorem of Sylvester" (March 2005).

The National Undergraduate Programme

In 1998, CMI initiated a National Undergraduate Programme in the Mathematical Sciences in collaboration with Madhya Pradesh Bhoj (Open) University with a 3 year course in Mathematics and Computer Science, leading to a B.Sc. Honours degree. In 2001, this programme was extended to the postgraduate level with separate 2 year courses leading to M.Sc. degrees in Mathematics and Computer Science. The scope of the undergraduate programme was expanded in 2003 to incorporate a 3 year course leading to a B.Sc. Honours degree in Physics.

The undergraduate and postgraduate teaching programmes at CMI are both run in cooperation with the Institute of Mathematical Sciences (IMSc), Chennai. These programmes tap the teaching talent available at the elite research institutes of the country, which are normally outside the university system. Students are thus exposed to lectures by active researchers who bring a very different perspective to the teaching.

B.Sc. (Mathematics)

In 2004, the seventh batch of students was admitted to the undergraduate programme. 25 students were offered admission and 7 have joined the programme. As usual, this batch contains students who won medals at the IMO and IOI as well as students giving up seats in prestigious institutions like the IITs.

The second year B.Sc. class has 10 students, while the third year B.Sc. class has 12 students.

Out of the 10 students of the 2001 batch who took their degrees at the convocation in August, 2004, several have been placed in very prestigious institutions. Anandam Banerjee has joined Northeastern University, USA. Kuntal Banerjee has joined the HRI, Allahabad as a Junior Research Fellow. Romie Banerjee has joined the Johns Hopkins University, USA. Raghav Kulkarni, who won the CMI medal

of excellence, has joined the University of Chicago, USA. Rishi Raj has been offered a Junior Research Fellowship (JRF) at the CMI itself. S. Akshay has joined IMSc as a JRF. Arnab Saha and Ritwik Banerjee have joined the CMI M.Sc. (Mathematics) programme. Dibyajyoti Deb has joined the University of Kentucky, USA.

B.Sc. (Physics)

This programme was started in 2003 with the assistance of the Physics Faculty of the IMSc., Chennai, and the active participation of physicists across the country. The senior batch, now in the second year, has 5 students.

In 2004, letters of admission were offered to 18 students, of whom 5 students have joined the programme. One student, who joined the programme last year and left, has re-joined the programme this year, taking the total strength of this class to 6.

During the course of the academic year, Physics students perform some basic experiments in class at CMI. In addition, students have an intensive laboratory programme at the Homi Bhabha Centre for Science Education (HBCSE), Mumbai, during the summer vacation after the first year. A similar arrangement has been worked out with the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam for students at the end of the second year. Regular laboratory classes will be conducted with the help of IIT Madras for students in the third year. A full-fledged in-house laboratory will be available once CMI moves to its permanent campus.

M.Sc. (Mathematics)

Of the 2001 batch, one remaining student completed the M.Sc. programme in 2004 and got his degree in August, 2004.

In 2002, three students were admitted to the programme and 2 completed the programme and got their degrees in 2004. Debajyoti Nandi has joined the Ph.D. programme at Rutgers University, USA.

Pradipto Banerjee has joined the University of North Carolina, USA. The remaining student is expected to complete the course by April 2005.

Five students joined the programme in 2003 out of which two have discontinued.

In 2004, six students (including one as JRF) have joined the programme.

M.Sc. (Computer Science)

Of the eight students who joined the MSc programme in Computer Science in 2002, seven have successfully completed the course in 2004. Shobhit Verma has joined the University of Pennsylvania, USA for a Ph.D. in Computer Science. Saket Saurabh has joined IMSc for a Ph.D. in Computer Science. Navin Rustagi has joined the University of New Mexico, USA, for a Ph.D. in Computer Science. Lini Thomas has joined IIIT, Hyderabad to pursue MS by Research. Debadyuti Roy will be joining the University of Michigan for a Ph.D. in 2005. Abeni Tandon and R. Koushik have taken up jobs in the industry. Awaneesh Kumar Upadhyay will be completing his M.Sc. in 2005.

Anindya Mozumdar, who completed a BSc at CMI and joined as a Ph.D. student in Mathematics in 2003, has switched over to Computer Science. He is now taking courses towards an MSc in Computer Science.

Undergraduate/Graduate Courses

Course	Instructor
Algebra I	K.R. Nagarajan
Calculus I	D.S. Nagaraj, IMSc., Chennai
English	Shreekumar Varma
Classical Mechanics I	P.P. Divakaran
Introduction to Programming I	Madhavan Mukund
Algebra III	Clare D'Cruz
Analysis I	A. Prasad, IMSc., Chennai
Calculus III	Suresh Nayak
Algorithms	V. Arvind, IMSc., Chennai
Algebra IV	V. Balaji
Theory of Computation	Rani Siromoney & K. Narayan Kumar
Ordinary Differential Equations	M.G. Nadkarni
Differential Geometry	C.S. Aravinda
Operations Research	K.V. Subrahmanyam
Properties of Matter	R. Shankar, IMSc., Chennai
Quantum Mechanics I	Tulsi Dass
Mathematical Physics	R. Jagannathan, IMSc., Chennai
Classical Mechanics I	P.P. Divakaran
Algebra	R. Sridharan
Measure & Integration	M.K. Vemuri
Geometry	Shiva Shankar
Representation Theory	S.S. Kannan
Ergotic Theory of Geodesic Flows	C.S. Aravinda
Computer Security	P. Vanchinathan
Databases	Madhavan Mukund
Verification	Bharat Adsul
Networks	Narayan Kumar

Course	**Instructor**
Distributed Computing	S.P. Suresh
Operating Systems	C. Prakash
Algebra II	S. Ramanan
Calculus II	Axelle Ziegler, Sylvain Ervedoza, Xavier Gendre & Rodolphe Richard, ENS, France
Discrete Mathematics	Bharat Adsul
Introduction to Programming II	S.P. Suresh
Economics	Lakshmi Kumar, IFMR, Chennai
Analysis II	P. Sankaran, IMSc., Chennai
Computer Organization	K. Narayan Kumar
Topology	Shiva Shankar
Programming Language Concepts	Madhavan Mukund
Probability	P Vanchinathan
Partial Differential Equations	M.K. Vemuri
Elementary Algebraic Geometry	Suresh Nayak
Representation Finite Groups	P. Vanchinathan/V. Balaji
Classical Mechanics II	M.V.N. Murthy, IMSc., Chennai
Electromagnetism I	R. Parthasarathy, IMSc., Chennai
Statistical Mechanics	K.P.N. Murthy, IGCAR, Kalpakkam
Electromagnetism II	H.S. Mani
Atomic & Molecular Physics	S.V.M. Satyanarayana, IGCAR, Kalpakkam
Quantum Mechanics II	G. Rajasekaran
Analysis II	P. Sankaran
Algebra	R. Sridharan
Functional Analysis	S. Kesavan, IMSc., Chennai
Representation of Finite Groups	P. Vanchinathan/V. Balaji
Algebraic Topology	V. Balaji
Algebraic Groups II	S.S. Kannan
Logic	R. Ramanujam, IMSc., Chennai
Compilers	K.V. Subrahmanyam

Activities of the undergraduate students

CMI Inter-College Symposium 2004-05 – Fiesta Mathematica

A one day national level Inter-College Symposium was conducted by the students of CMI in March 2005. Competitions were conducted in two subject areas, Mathematics and Computer Science. Students from more than fifteen colleges including IIT-Madras, Madras Institute of Technology, Vellore Institute of Technology, KCG College of Technology, Vellamal College of Engineering, St. Joseph College of Engineering participated in various events like Online Programming Contest, Paper Presentation, Dumb C, Crossword, Math Olympiad, Algo Fun (CS Olympiad) and Oracle (Quiz).

Informatics Olympiad

CMI faculty coordinate the training and selection of students to represent India at the International Olympiad in Informatics through the Indian Association for Research in Computer Science (IARCS). CMI hosts the official IARCS website. From September 2004, a monthly online programming competition has been conducted by the CMI faculty via the IARCS website.

Achievements of CMI students

- Vipul Naik, a first year student in the B.Sc. Mathematics programme, won a silver medal at the International Mathematics Olympiad at Athens, 2004. His classmate, R Shreevatsa, won a bronze medal at the International Olympiad in Informatics at Athens, 2004.

- The well-known software company Google conducted a programming contest open to all individuals in South Asia. Three of our students, R Shreevatsa (1st year B.Sc. Mathematics), Indraneel Mukherjee (2nd year B.Sc. Mathematics) and Tanmoy Chakraborty

(2nd year B.Sc. Mathematics) qualified in the top 50 and took part in the final phase. Shreevatsa and Indraneel finished in the top 12 overall.

- SANKHYA 2004 (Sri Venkateswara Engineering College, August 2004)

Event	Participants	Place
Applex (an event based on Applied Math)	Tapopriya Majumdar Raghunath Tewari Amruth Krishnan	I
Crossword	Tapopriya Majumdar Raghunath Tewari Amruth Krishnan	III

- Shaastra 2004 (IIT Madras, October 2004)

Event	Participants	Place
Programming Contest	Tanmoy Chakraborty Shreevatsa R	II

- Physics Quiz (conducted by Indian Institute of Technology, Madras, in November 2004 on the occasion of Sir C.V.Raman's birthday)

Event	Participants	Place
Quiz	Deep Roy A.K.S. Chand	I
Quiz	Pramod Padmanabhan P.Bhanukiran	II

- INFINITY 2005 (Crescent Engineering College, February 2005)

Event	Participants	Place
Maths Quiz	Arul Shankar Shreevatsa R Ramprasad Saptarishi	I
IQ Test	Shreevatsa R	III

Summer camps/courses/visits to other centres:

- Amruth Krishnan participated in the summer programme conducted by KVPY at the Indian Institute of Sciences, Bangalore during June–July 2004 and Underwent a reading course in algebraic topology under Prof.C.R.Pradeep as a part of this program.

  Received cash award of Rs.10,000/- from the Actuarial Society of India for clearing 3 subjects in concurrently during the May 2004 examination, successfully completed the Level - I French course(160 hours) conducted by Alliance Francaise de Madras with grade EXCELLENT, during October 2004-March 2005, received offers for admission to PhD program in mathematics from Caltech, Rutgers, SUNY at Stony Brook, Purdue and International University Bremen, Germany. Also got admitted to the ALGANT Masters program in mathematics and recipient of the ICICI Research Centre Scholarship for PGPF program at IFMR.

- B. Prasanna Venkatesh attended summer course at the Indian Institute of Sciences under Prof. Arnab Rai Chaudhuri as part of Young Science Fellowship.

- Sushmita Gupta visited the Indian Institute of Technology, Bombay during May to June 2004 and studied under Prof. Sundar Vishwanathan.

Interaction with graduate students from Ecole Normale Supérieure, Paris.

Chennai Mathematical Institute has an agreement with the Ecole Normale Supérieure in Paris, France, one of the leading institutions in the world for teaching and research in Mathematics. This agreement provides for regular exchange visits by academic members of CMI and ENS, Paris. This includes, in particular, exchanges of visits by undergraduate students between the two institutions.

The exchange programme with the Ecole Normale Supérieure (ENS), Paris, is all set to receive a new impetus thanks to a new arrangement which will strengthen the commitment of that institution to our teaching programme. Under the new arrangement, starting from January 2005, the four annual visitors from the ENS will now arrive in two groups: two for the period January–February and two for the period March–April. Together, these four will be completely responsible for the teaching, examination and evaluation for the course Calculus II (which is taught in the second semester of the I B.Sc. class). The first pair of visitors will handle the course up to the mid-semester examination and the second pair will continue from that point up to the final examination. Of the two personnel present at a time, one will deliver the lectures for the course while the other will handle tutorials in the manner of the *travaux dirigés* of the French university system.

A. Saurin and M. Wouts of the ENS visited the CMI during August–September, 2004. They gave special seminar courses on *Proof Theory and Computation* and *Probability Theory*, respectively. In January–February, 2005, Axelle Ziegler and Sylvain Ervedoza from ENS visited CMI. Xavier Gendre and Rodolphe Richard visited CMI during March–April, 2005.

Every year, the top three students passing out from the B.Sc. Mathematics progrmme spend 8 weeks at the ENS, where they work on research projects with the ENS faculty. In May–June, 2004, Anandam Banerjee, Raghav Kulkarni and Rishi Raj visited the ENS.

Dr. C.N. GANGADARAN
B.Com., FCA, MBIM (Lond.), Ph.D.
S. NEELAKANTAN
B.Com., FCA
R. THIRUMALMARUGAN
M.Com., FCA
G. CHELLA KRISHNA
M.Com., ACA, PGDM

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D. KALAIALAGAN
B.Com., FCA
B. RAMAKRISHNAN
B.Com., FCA, Grad. CWA
V. VIVEK ANAND
B.Com., FCA

CHENNAI MATHEMATICAL INSTITUTE

We have audited the accounts of CHENNAI MATHEMATICAL INSTITUTE for the year ended 31.03.2005, the annexed Balance Sheet and the annexed Income and Expenditure Account for the year ended on that date.

1. We have obtained all the information and explanation which to the best of our knowledge and belief were necessary for the purpose of our audit.

2. In our opinion, proper records of accounts required by law have been kept by the Institute as far as it appears from our examination of such books.

3. The Balance Sheet and Income and Expenditure Account dealt with by the report are in agreement with the books of accounts.

4. In our opinion and to the best of our information and according to the explanations given to us, the accounts give a true and fair view:

   a) In the case of the Balance Sheet of the state of affairs of the Institute as at 31.03.2005.

   b) In the case of the Income and Expenditure Account, of the excess of Income over Expenditure on that date.

for CNGSN & ASSOCIATES
Chartered Accountants

Sd./=
C.N. Gangadaran
(Partner)
Memb.No.11205

Place: Chennai-17
Date: 10.10.2005

CHENNAI MATHEMATICAL INSTITUTE

Income & Expenditure Account for the year ended 31st March 2005

Y.E 31 03 2004	EXPENDITURE	Y.E 31 03 2005	Y.E. 31 03 2004	INCOME	Y.E 31 03 2005
307739.00	Advertisement	328374.00	245163.26	Interest Received	1305625.92
5692895.30	Salary & Wages	7664354.38	821912.00	Miscellaneous Income	455011.90
124307.00	Post, Teleg & Telephones	132532.60		As per Schedule L	
2816295.00	Rent & Electricity	3205487.00	19000000.00	Donations	21500150.00
702885.00	Travel & Conveyance	1071322.00		As per Schedule M	
99790.50	Printing & Stationery	91226.00			
569925.00	Books & Journals	683230.00			
192029.50	Welfare	203171.50			
179718.00	Visitors Hon & Fees	411679			
278117.00	Repairs & Maintenance	247379.00			
9725.00	Bank Charges&Interest	28919.21			
3240.00	Audit Fees	7670.00			
30669.00	Insurance	32941.00			
51673.00	Miscellaneous	180617.00			
0.00	Physics Lab Charges	127992.50			
1179040.00	Res. St. Stipend	1357760.00			
56709.00	PF Admn. Chgs.	72122.00			
22363.00	Medical Expenses	20649.00			
199092.50	Organisational Exps.	165609.00			
153874.00	Subscription (Dishnet)	545691.00			
	Excess of Income				
7396988.46	over Expenditure	**6682061.63**			
20067075.26		23260787.82	20067075.26		23260787.82

Sd./=
Dr. A.C. Muthiah
Founder Trustee

Sd./=
Shri M.G. Thirunavukkarasu
Trustee

Sd./=
Shri A. Muthukumar
Trustee Secretary

Place: Chennai
Date : 10.10.2005

For CNGSN & ASSOCIATES
Chartered Accountants

Sd./=
C.N Gangadaran
Partner

CHENNAI MATHEMATICAL INSTITUTE

Balance Sheet as at 31st March 2005

Y.E 31 03 2004	LIABILITIES	Y.E 31 03 2005	Y.E. 31 03 2004	ASSETS	Y.E 31 03 2005
8680584.00	**Corpus Funds** As per Schedule A	8719597.00	12573288.00	**Fixed Assets** As per Schedule G	23165925.00
4780000.00	**Endowment Funds** As per Schedule B	4780000.00			
343530.00	**Project Funds** As per Schedule C	312820.00	225062.00	**Loans & Advances** As per Schedule H	946319.00
0.00	**Building Fund** As per Schedule D	6000000.00			
1614350.00	**Current Liabilities** As per Schedule E	3035691.00	1832192.00	**Deposits** As per Schedule I	1880946.00
10663513.89	**Income and Expenditure A/c.** As per Schedule F	17345575.52	10853507.00	**Investments** As per Schedule J	8411007.00
			597928.89	**Cash & Bank Balances** As per Schedule K	5789486.52
26081977.89		40193683.52	26081977.89		40193683.52

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Place: Chennai
Date : 10.10.2005

For CNGSN & ASSOCIATES
Chartered Accountants

Sd./=
C.N Gangadaran
Partner