Chennai Mathematical Institute

National Undergraduate and Postgraduate
Programmes in Mathematical Sciences

Information brochure, 2010–2011

3 Year B.Sc. (Honours) Course in Mathematics and Computer Science
3 Year B.Sc. (Honours) Course in Physics
2 Year M.Sc. Course in Mathematics
2 Year M.Sc. Course in Computer Science
2 Year M.Sc. Course in Applications of Mathematics
Ph.D in Mathematics
Ph.D in Computer Science

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The Chennai Mathematical Institute

Chennai Mathematical Institute (CMI), a university under Section 3 of the UGC Act 1956, is recognized both within the country and abroad as one of the important centres in India for research and teaching in mathematical sciences. CMI is set up under a Trust and is managed by a Governing Council made up of eminent personalities from both academic and non-academic backgrounds. The academic matters of the Institute are guided by its Research Advisory Committee consisting of highly respected scientists. The teaching programmes are overseen by the Academic Council, consisting of senior faculty from CMI and other leading institutions across India. The members of the Governing Council, Research Advisory Committee and Academic Council are listed on the front and back inside covers.

Research at CMI

Professor C. S. Seshadri, F.R.S., an internationally renowned mathematician, has headed the Institute since its inception. The Institute has a talented group of faculty members who have strong academic ties with reputed institutions in India and abroad. The Institute also attracts a regular stream of academic visitors, both from India and abroad.

The main areas of research in Mathematics pursued at the Institute are algebra, analysis, differential equations, geometry and topology. In Computer Science, the main areas of research are formal methods in the specification and verification of software systems, design and analysis of algorithms, computational complexity theory and computer security. In Physics, research is being carried out mainly in quantum field theory, string theory and mathematical physics.

The Institute has a well established Ph.D. Programme in Mathematics and Computer Science.

Teaching at CMI

It has always been the aim of the Institute to pursue excellence not only in research but in teaching too. It is recognized all over the world that academic excellence is best cultivated by enabling the interaction between high quality researchers and talented students. In India, this

interaction has been inhibited by the fact that most research institutions have been set up outside the university system. As a result, the wealth of scholarship and teaching talent that is available in our research institutions cannot be tapped by students in our colleges and universities. There is a national need for educational institutions of quality to train our talented students at both B.Sc. and M.Sc. levels.

With this in mind, CMI initiated, in 1998, a 3-year course in Mathematics and Computer Science leading to a B.Sc. (Honours) degree. The aim is to train a select group of talented students for academic and professional careers requiring exceptional mathematical and computational skills. In 2001, the teaching programme at CMI was extended to include separate 2-year M.Sc. courses in Mathematics and Computer Science. Given the success of the undergraduate programme in Mathematics at CMI, the teaching programme was extended in 2003 to include a 3-year B.Sc. (Honours) programme in Physics. From 2010, the Institute is starting a new M.Sc. course in Applications of Mathematics.

In the initial years, the degrees were awarded by the Madhya Pradesh Bhoj (Open) University (MPBOU), Bhopal. In December 2006, CMI was recognized as a university under Section 3 of the UGC Act 1956. CMI now awards B.Sc., M.Sc. and Ph.D. degrees directly.

The Curriculum and the Teaching Faculty

The teaching curriculum is perhaps the best that is available in the country at the undergraduate and postgraduate levels.

The B.Sc. (Honours) Mathematics and Computer Science curriculum covers basic and advanced undergraduate courses in Mathematics. The programme also includes a number of courses on fundamental topics in Computer Science, including the design and analysis of algorithms, programming languages and computability theory. The courses are taught by active researchers in mathematics and computer science who draw on their professional expertise to offer new insights into the subject material.

The B.Sc. (Honours) Physics curriculum covers basic undergraduate courses in Physics in topics such as classical mechanics, electromagnetism, thermodynamics, statistical and quantum physics. It also includes courses in programming and mathematics and offers an introduction to some advanced topics like relativity, cosmology, quantum field theory and condensed matter physics.

Physics students perform basic experiments at the in-house laboratory in CMI's new campus. 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.

The M.Sc. curriculum takes the students into more advanced topics in Mathematics and Computer Science. The course structure is flexible and designed so that students can lay a firm foundation for pursuing further research while also acquiring advanced skills that will enhance their effectiveness in professional careers.

All students at CMI have access to a well-equipped computer laboratory with a high-speed Internet connection and are strongly encouraged to acquire computer related skills as part of their education.

The B.Sc. (Honours) Programme consists of six semesters of study over three years. The M.Sc. Programmes generally consist of four semesters of study over two years. Each year, the first semester runs from August to November and the second semester runs from January to April. The new M.Sc. Programe in Applications of Mathematics has a slightly different structure in the second year, with two shorter terms followed by an internship or project.

The teaching programmes at CMI are run in cooperation with the Institute of Mathematical Sciences (IMSc), Chennai. The courses are taught by the faculty of CMI and IMSc, Chennai, as well as distinguished visiting scientists from other academic institutions such as the Tata Institute of Fundamental Research (TIFR), Mumbai, the Indian Statistical Institute (ISI), IGCAR, Kalpakkam, IIT Madras, Chennai, the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune and the Ecole Normale Supérieure (ENS), Paris.

Humanities

Chennai Mathematical Institute is also building up activities in the Humanities. The undergraduate programme includes two compulsory Humanities courses. The Institute has adjunct faculty in Literature and Music. A number of seminars have been organized in recent years in these subjects.

Exchange Programmes

Chennai Mathematical Institute has a formal agreement with the Ecole Normale Supérieure in Paris, France, one of the leading institutions in the world for teaching and research in Mathematics, for regular exchanges of visits by academic members of CMI and ENS, Paris.

Each year, top-ranking senior B.Sc. Mathematics and Computer Science students from CMI spend the summer at ENS working on research problems with faculty there. In return, four members of ENS visit CMI each year to participate in research and to teach a complete course in the B.Sc. programme.

The Institute now has a similar arrangement with Ecole Polytechnique in Paris wherby top-ranking senior B.Sc. Physics students spend the summer in Paris working on research problems with faculty at Ecole Polytechnique.

The Institute also has a formal agreement with the Ecole Normale Supérieure in Cachan, France, for exchange of B.Sc. and M.Sc. students as well as for a joint Ph.D. programme in Computer Science and Mathematics.

Links with other institutions

CMI has signed an agreement with the Society for Electronic Transactions and Security (SETS), Chennai to cooperate on research and teaching related to cryptography and security. SETS provides a special scholarship for M.Sc. students interested in cryptography, based on an interview after joining CMI's M.Sc. programme.

The Institute has also entered into an active partnership with Microsoft Research India (MSR), Bangalore. Students from CMI can take up internships at MSR. In addition, faculty at both institutions will collaborate actively in teaching and research.

Placement

Students from CMI have gone on to pursue further studies at the best academic institutions in India and abroad. These include Caltech, Chicago, MIT, Princeton, U Penn and Yale in USA, ENS Paris, Univ Paris-Sud and Univ Bordeaux in France, the Max Planck Institutes and Humboldt University in Germany and the Harish-Chandra Research Institute, IITs, IMSc, ISI and TIFR in India.

Though the majority of students from the Institute continue in Mathematics, Computer Science and Physics, CMI graduates have also moved into areas such as financial mathematics (at IFMR), management (at IIM) and economics (both in India and abroad). Students from CMI have also been placed in some of the best software companies in India.

Campus and Hostel Facility

The Institute's campus is located in the SIPCOT Information Technology Park in Siruseri, on the outskirts of Chennai. CMI's programme is fully residential. All students are accommodated in the hostel on campus. The Institute has a regular transportation arrangement for students to visit the city for shopping and other activities.

Students pay hostel and mess fees at the beginning of each semester. Currently, the amount payable is Rs. 15,400 per semester, (Rs. 4,000, Rs. 9,000 and Rs. 2,400 towards hostel fees, mess charges and establishment charges respectively). These charges are adjusted periodically to account for inflation.

Funding

One of the unique features of CMI in the Indian context is that its funding comes from diverse sources, both public and private. This has given the Institute the freedom to organize its activities in a manner that is best suited to achieving its goal of excellence in research and teaching.

The Institute receives substantial support for its activities from the Department of Atomic Energy (DAE), through the National Board for Higher Mathematics (NBHM). In addition, the Institute has received a major grant for the period 2006–2009 from the Board of Research in Nuclear Sciences (BRNS) and the Department of Science and Technology (DST).

The Institute also receives generous contributions from the private sector. During the formative years of the Institute, the Southern Petrochemical Industries Corporation (SPIC) has been a major source of funding and infrastructural support for CMI. Currently, the Shriram Group Companies, Chennai play a crucial role in providing and organizing private funding for the Institute.

The land for the new Institute campus at Siruseri was acquired

through a grant from the Shriram Group Companies. Major financial contributions towards building up the new campus have come from Matrix Laboratories, Hyderabad, the Chennai Willingdon Corporate Foundation, Take Solutions, Chennai, the Infosys Foundation, Bangalore and Tata Consultancy Services. A new building with an auditorium, guest rooms, hostel rooms and additional office space is currently being constructed with funds from the Ministry of Human Resource Development (MHRD) via the University Grants Commission (UGC).

The Institute receives a generous annual grant from Tata Consultancy Services to support academic activities. Microsoft Research has also provided substantial support through research and travel grants.

In addition to grants from government and private sources, CMI also receives funding for research projects from government agencies such as Department of Science and Technology (DST) and Defence Research Development Organization (DRDO) as well as from private organizations.

B.Sc. (Honours) Programmes (Mathematics and Computer Science, Physics)

Admission and eligibility Students who have already passed, or expect to pass in 2010, the 12th standard (or equivalent) examination from a recognized board are eligible for admission to the programme. Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 27, 2010**. Students with exceptionally good performance in National Science Olympiads may be exempted from writing the entrance examination at the discretion of the Admissions Committee. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in`.

Fees and scholarships There will be a fee of Rs.750/- per semester (two semesters in a year). A limited number of scholarships will be available. A full scholarship will consist of the waiver of tuition fees and a monthly allowance of Rs. 3000. A half-scholarship will consist of the tuition fee being waived. The eligibility of a student to receive a scholarship will be reviewed every semester and will depend on satisfactory academic performance. All students of B.Sc. (Honours) will receive an additional monthly scholarship of Rs. 2000, made possible through a generous private donation.

Course details

The **B.Sc. (Honours) Programme in Mathematics and Computer Science** is an integrated three-year course in Mathematics and Computer Science. The following is the semester-wise schedule of courses.[1]

Semester I	**Semester II**
Algebra I	Advanced Programming
Calculus I	Algebra II
Humanities I (English)	Calculus II
Introduction to Programming	Discrete Mathematics
Physics I	Probability Theory

[1] Small variations may be incorporated in this schedule, as recommended by the Academic Council.

Semester III

Algebra III
Calculus III
Design and Analysis of Algorithms
Real Analysis
Theory of Computation

Semester IV

Complex Analysis
Differential Equations
Programming Language Concepts
Topology
Optional Course I

Semester V

Algebra IV
Mathematical Logic
Mathematics/Computer Science Optional Course I
Optional Course II

Semester VI

Humanities II
Mathematics/Computer Science Optional Course II
Optional Course III
Optional Course IV

One of the four Optional Courses must be a Physics course.

The following is the semester-wise schedule of courses for the **B.Sc. (Honours) Programme in Physics**.[2]

Semester I

Classical Mechanics I
Electromagnetism I
Introduction to Programming
Humanities I (English)
Mathematical Physics I
Physics Laboratory I

Semester II

Electromagnetism II
Mathematical Physics II
Quantum Mechanics I
Statistical Mechanics I
Physics Laboratory II

Semester III

Classical Mechanics II
Electromagnetism III
Mathematical Physics III
Quantum Mechanics II
Statistical Mechanics II
Physics Laboratory III

Semester IV

Atomic and Molecular Physics
Classical Mechanics III
General Theory of Relativity
Quantum Mechanics III
Statistical Mechanics III

[2]Small variations may be incorporated in this schedule, as recommended by the Academic Council.

Semester V	**Semester VI**
Condesned Matter Physics	Humanities II
Nuclear and Particle Physics	Quantum Field Theory
Optional Course I	Optional Course III
Optional Course II	Project, Part II
Project, Part I	

The three Optional Courses in the third year should all be Mathematics courses.

Detailed information about the courses is available at the CMI website, `http://www.cmi.ac.in`.

M.Sc. Programme in Mathematics

Admission and eligibility Students who have obtained, or expect to obtain in 2010, degrees such as B.Sc., B.Math., B.Stat. or B.Tech. are eligible to apply for the programme. Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 27, 2010**. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in`.

Fees and scholarships The total tuition fees for the M.Sc. programme in Mathematics will be Rs. 4800. A limited number of scholarships will be available. A full scholarship will consist of a waiver of tuition fees and a monthly allowance of Rs. 5000. A half-scholarship will consist of the tuition fees being waived. The eligibility of a student to receive a scholarship will be reviewed every semester and will depend on satisfactory academic performance.

The Society for Electronic Transactions and Security (SETS), Chennai, provides a limited number of special scholarships for M.Sc. Mathematics or Computer Science students interested in cryptography. These scholarships are granted on the basis of an interview after joining CMI's M.Sc. programme.

Courses

Students in this programme will be expected to complete the equivalent of 16 regular courses, normally over a period of four semesters, as follows.

Semester I

Linear Algebra
Algebra I
Advanced Calculus
Real Analysis

Semester II

Algebra II
Complex Analysis
Topology
Differential Equations

Semester III

Measure Theory
Algebraic Topology
Elective I
Elective II

Semester IV

Functional Analysis
Differential Geometry
Elective III
Elective IV

At the discretion of the admissions committee, a student who has already completed any of the compulsory courses as an undergraduate may substitute these courses by a suitable number of optional courses to make up the overall course requirements.

There is also the possibility of substituting some regular courses in with a dissertation, written under the supervision of one of the faculty members.

The list of elective courses being offered each year will be announced at the beginning of the academic year. Detailed information about all courses is available at the CMI website, `http://www.cmi.ac.in`.

M.Sc. Programme in Computer Science

Admission and eligibility Students who have obtained, or expect to obtain in 2010, degrees such as B.Sc., B.E. or B.Tech. in Computer Science, or B.Sc. in Mathematics with a strong background in Computer Science, are eligible to apply for the programme. Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 27, 2010**. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in`.

Fees and scholarships The total tuition fees for the M.Sc. programme in Computer Science will be Rs. 4800. A limited number of scholarships will be available. A full scholarship will consist of a waiver of tuition fees and a monthly allowance of Rs. 5000. A half-scholarship will consist of the tuition fees being waived. The eligibility of a student to receive a scholarship will be reviewed every semester and will depend on satisfactory academic performance.

The Society for Electronic Transactions and Security (SETS), Chennai, provides a limited number of special scholarships for M.Sc. Mathematics or Computer Science students interested in cryptography. These scholarships are granted on the basis of an interview after joining CMI's M.Sc. programme.

Courses

The course work for the programme will consist of five categories, as follows.

1. **Core courses**

   Programming Languages
   Basic Programming Laboratory
   Design and Analysis of Algorithms
   Theory of Computation

2. **Foundational Topics courses**

   Advanced Algorithms
   Distributed Systems
   Mathematical Logic in Computer Science
   Computer Systems Verification

Algorithmic Complexity theory
Operations Research
Cryptography and Computer security
Probability and Statistics

3. **Systems courses**

   Networks
   Databases
   Compilers
   Software Engineering
   Advanced Computer Organization
   Digital Systems Design

4. **Advanced level courses**

   These will be offered from a list that will be updated periodically, including courses such as Mobile Computing, Computational Biology, Computational Geometry and Symbolic Computation.

5. **Project/Dissertation**

To earn an MSc, a student must complete the equivalent of 16 regular courses, normally over a period of four semesters. These 16 courses must include all five Core courses, at least two Foundational Topics courses, two Systems courses and a project or dissertation.

Each advanced level course is equivalent to two regular courses and the project/dissertation is equivalent to four regular courses. At the discretion of the admissions committee, a student who has already completed any of the core courses as an undergraduate may substitute these courses by a suitable number of alternative courses to make up the overall course requirements.

Detailed information about the courses is available at the CMI website, `http://www.cmi.ac.in`.

M.Sc. Programme in Applications of Mathematics

Admission and eligibility Students who have obtained, or expect to obtain in 2010, a B.Sc. degree in Mathematics, or degrees such as B.Sc. Physics, B.Sc. Statistics, B.E. or B.Tech. with a strong background in Mathematics, are eligible to apply for the programme. Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 27, 2010**. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in`.

Fees and scholarships The total tuition fees for the M.Sc. programme in Applications of Mathematics will be Rs. 4800. A limited number of scholarships will be available. A full scholarship will consist of a waiver of tuition fees and a monthly allowance of Rs. 5000. A half-scholarship will consist of the tuition fees being waived. The eligibility of a student to receive a scholarship will be reviewed every semester and will depend on satisfactory academic performance.

Courses

The programme is currently oriented towards two streams, financial mathematics and applications in computation. The first year of the two year course consists of two regular semesters of course work. The second year will have two shorter terms of course work, followed by an internship or project.

The course work for the two streams are as follows.

Financial Mathematics

Ist year

Semester 1 (Aug-Nov)	*Semester 2 (Jan-Apr)*
Linear Algebra	Measure Theoretic Probability
Analysis	Differential Equations
Probability and Statistics	Algorithms
Programming Techniques	Economics

IInd year electives

Term 3 (Aug-Oct)	*Term 4 (Nov-Jan)*
Stochastic Processes	Finance II
Econometrics I	Econometrics II
Finance I	Simulation Methods
Computational Methods	Risk Managemenent

Applications in Computation

Ist year

Semester 1 (Aug-Nov)	*Semester 2 (Jan-Apr)*
Linear Algebra	Discrete Mathematics
Analysis	Differential Equations
Probability and Statistics	Algorithms
Programming Techniques	Economics

IInd year electives

Term 3 (Aug-Oct)	*Term 4 (Nov-Jan)*
Applied Statistics	Algorithms on Strings, Trees and Sequences
Advanced Algorithms	Text and Web Mining
Data Mining Techniques	Cryptography
Simulation Techniques	Verification

Internship/Project

In both streams, the student will be required to complete an internship or project from February to June, at the end of the second year of the programme.

Detailed information about the courses is available at the CMI website, `http://www.cmi.ac.in`.

Ph.D. Programmes (Mathematics, Computer Science)

Admission and eligibility Students with an M.Sc. degree in Mathematics or equivalent and students with a bachelors degree in Engineering or Science with a strong aptitude for research are eligible to apply for the Ph.D. programme in Mathematics.

Students with a B.E., B.Tech., M.Sc., or M.C.A. degree and students with a bachelors degree in Science with a strong aptitude for research are eligible to apply for admission to the Ph.D. programme in Computer Science.

Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 27, 2010**, followed by an interview in Chennai. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in`.

Fees and scholarships Research Scholars get a stipend of Rs 12000 per month for the first two years and Rs 14000 per month for the next three years. Scholars who do not stay in the hostel are eligible for a house rent allowance of 30% of stipend per month. The scholarship amounts are revised periodically, and are on par with the premier research institutes in India.

Courses and research Students admitted to the Ph.D. programme are expected to complete one year of compulsory course work. After this, students are assigned guides and begin their research work. Their progress is monitored periodically by a doctoral committee.

Part-Time PhD Programme

CMI has a part-time PhD programme to allow students to complete a PhD while continuing to work for their parent organisations. Part-time students are admitted based on an entrance examination and an interview, like regular PhD students. Students must already have a Masters degree to be admitted to the part-time PhD programme. There is a minimum residency requirement of two semesters, which can be spread over the first two years of the programme.

Chennai Mathematical Institute
Governing Council

1. Shri A.C. Muthiah (Chairman),
   Chairman, SPIC Ltd., Chennai

2. Prof. R. Balasubramanian,
   Director, Institute of Mathematical Sciences, Chennai

3. Prof. M.S. Raghunathan, F.R.S.,
   Tata Institute of Fundamental Research, Mumbai

4. Prof. C.S. Seshadri, F.R.S.,
   Director, Chennai Mathematical Institute, Chennai

5. Shri R. Thyagarajan,
   Chairman, Shriram Group Companies, Chennai

6. Prof. P.S. Thiagarajan,
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7. Shri Jawahar Vadivelu,
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   Courant Institute of Mathematical Sciences,,
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Chennai Mathematical Institute,
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7. Prof. S.G. Dani,
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   Chairman, National Board for Higher Mathematics
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   Director General, School of Good Governance and Policy Analysis, Bhopal
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