Chennai Mathematical Institute

National Undergraduate and Postgraduate
Programmes in Mathematical Sciences

Information brochure, 2014–2015

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

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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 academic personalities. 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 and Academic Council are listed on the front and back inside covers.

Research at CMI

The Institute is headed by Professor Rajeeva L. Karandikar, an internationally renowned mathematician. CMI was founded in 1989 by Professor C. S. Seshadri, F.R.S., who is presently Director-Emeritus. 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, probability, statistics, topology, number theory and differential geometry. 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, computational geometry and computer security. In Physics, research is being carried out mainly in gravitation, quantum field theory, string theory and mathematical physics.

The Institute has well established Ph.D. Programmes in Mathematics, Computer Science and Physics.

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. The Institute currently has two B.Sc. (Honours) programmes: Mathematics and Computer Science, and Mathematics and Physics, and three M.Sc. programmes: Mathematics, Computer Science, and 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.

All B.Sc. (Honours) students undergo the same core set of basic and advanced undergraduate courses in Mathematics. In addition, the B.Sc. (Honours) Mathematics and Computer Science curriculum 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. Students in the B.Sc. (Honours) Mathematics and Physics programme undergo, instead, basic undergraduate courses oriented towards theoretical Physics in topics such as classical mechanics, electromagnetism, thermodynamics, statistical and quantum physics. All these courses are taught by active researchers in mathematics, computer science and physics, who draw on their professional expertise to offer new insights into the subject matter.

The M.Sc. curriculum takes students into more advanced topics in Mathematics, Computer Science and Applications of Mathematics. 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) programmes consist of six semesters of study over three years. The M.Sc. programmes 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 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 École Normale Supérieure (ENS), Paris.

Humanities

Chennai Mathematical Institute is also building up activities in the Humanities. The undergraduate programme has two compulsory Humanities courses. The Institute has adjunct and visiting faculty in Literature and Music. A number of seminars have been organized in these subjects including the ongoing CMI Arts Initiative.

Exchange Programmes

Chennai Mathematical Institute has a formal agreement with the École 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, members of ENS visit CMI each year to participate in research and to teach in the B.Sc. programme.

The Institute has a similar arrangement with École Polytechnique in Paris whereby top-ranking senior B.Sc. Physics students spend the summer in Paris working with faculty at École Polytechnique.

The Institute also has a formal agreement with the École Normale

Supérieure in Cachan, France, for exchange of B.Sc. and M.Sc. students and for a joint Ph.D. programme in Computer Science and Mathematics.

CMI is one of three non-European partners in the Erasmus Mundus Master Programme ALGANT (ALgebra Geometry And Number Theory), funded by the European Union. The ALGANT programme allows students to pursue Masters and Doctorate degrees across the institutions participating in the programme.

Placement

Students from CMI have gone on to pursue further studies at the best academic institutions in India and abroad. These include Caltech, Chicago, Harvard, 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, management 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 start of each semester. Currently, the charges are Rs. 19,600 per semester, (Rs. 4,000, Rs. 13,200 and Rs. 2,400 towards hostel fees, mess 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). Additional support is expected from the Science and Engineering Research Board (SERB) of the Department of Science and Technology (DST), which has recently signed an agreement with DAE to jointly support CMI.

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 CMI's campus at Siruseri was acquired through a grant from the Shriram Group Companies. Major financial contributions towards building up the 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 Internet-enabled video classroom, guest rooms, and additional office space has been constructed with funds from the Ministry of Human Resource Development (MHRD) via the University Grants Commission (UGC). An additional grant has been received from MHRD/UGC to further extend this building.

The Institute 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 received a generous three year grant from Tata Consultancy Services from 2008–2011 to support academic activities. In addition, Microsoft Research has provided substantial support through research and travel grants.

CMI also receives funding for research projects, both from government agencies as well as from private organizations.

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

Admission and eligibility Students who have already passed, or expect to pass in 2014, 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 15, 2014**. 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/admissions`.

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. 4000. 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. 1000, 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
Classical Mechanics 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
Elective I

Semester V

Algebra IV
Mathematical Logic
Elective II
Elective III

Semester VI

Humanities II
Elective IV
Elective V
Elective VI

Of the six elective courses, two must be in Mathematics or Computer Science and one must be Quantum Mechanics I.

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

Semester I

Algebra I
Calculus I
Humanities I (English)
Introduction to Programming
Classical Mechanics I

Semester II

Algebra II
Calculus II
Probability Theory
Classical Mechanics II
Electrodynamics I

Semester III

Algebra III
Calculus III
Real Analysis
Quantum Mechanics I
Thermal Physics

Semester IV

Complex Analysis
Differential Equations
Topology
Optics
Quantum Mechanics II

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

Semester V	**Semester VI**
Algebra IV	Humanities II
Statistical Mechanics	Elective III
Elective I	Elective IV
Elective II	Elective V

Of the five elective courses, one must be a laboratory course and one must be Advanced Programming.

All students must complete a compulsory one semester non-credit course in Environmental Science.

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

M.Sc. Programme in Mathematics

Admission and eligibility Students who have obtained, or expect to obtain in 2014, 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 15, 2014**, followed by an interview in Chennai. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in/admissions`.

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. 6000. 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

Students in this programme will be expected to complete the equivalent of 16 regular courses, normally over a period of four semesters, as follows.[3]

Semester I

Algebra I
Real Analysis
Topology
Differential and Integral Equations

Semester II

Algebra II
Complex Analysis
Measure Theory
Differential Geometry

Semester III

Commutative Algebra
Algebraic Topology
Functional Analysis
Elective I

Semester IV

Harmonic Analysis
Elective II
Elective III
Elective IV

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

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 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/teaching`.

M.Sc. Programme in Computer Science

Admission and eligibility Students who have obtained, or expect to obtain in 2014, degrees such as B.Sc., B.E. or B.Tech. in Computer Science, B.C.A. 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 15, 2014**. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in/admissions`.

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. 6000. 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

To earn an MSc, a student must complete the equivalent of 16 regular courses, normally over a period of four semesters. These 16 courses include four Core courses and a project/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.

The course work for the programme will consist of five categories, as follows.[4]

1. **Core courses**

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

2. **Foundational Topics**

   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. **Applied Topics**

   Networks
   Databases
   Compilers
   Software Engineering
   Advanced Computer Organization
   Data Mining

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**

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

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

M.Sc. Programme in Applications of Mathematics

Admission and eligibility Students who have obtained, or expect to obtain in 2014, 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 15, 2014**, followed by an interview in Chennai. Details about the admission procedure are available at the CMI website, `http://www.cmi.ac.in/admissions`.

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. 6000. 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

There are two streams offered at present, Financial Mathematics and Applications in Computing. A student must complete 13 core courses and 3 electives, normally over a period of four semesters. The 3 electives may be be substituted by a thesis/project. The list of core and elective courses is given below.[5]

Financial Mathematics

Core courses, first year

Semester I	**Semester II**
Linear Algebra	Measure Theoretic Probability
Analysis	Differential Equations
Probability and Statistics	Algorithms
Programming Techniques	Economics

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

Core courses, second year

1. Stochastic Processes I
2. Finance I
3. Finance II
4. Econometrics I
5. Econometrics II

Applications in Computing

Core courses, first year

Semester I	**Semester II**
Linear Algebra	Discrete Mathematics
Analysis	Differential Equations
Probability and Statistics	Algorithms
Programming Techniques	Economics

Core courses, second year

1. Theory of Computation
2. Programming Language Concepts
3. Data Mining
4. Verification
5. Cryptography

Elective courses (both streams)

1. Stochastic Processes II
2. Computational Methods
3. Simulation Methods
4. Risk Management
5. Applied statistics (Time Series)
6. Applied statistics (Classification and Regression techniques)
7. Randomized Algorithms
8. Algorithms on Strings, Trees and Sequences
9. Security Protocols

In addition, any core course from another stream may be taken as an elective.

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

Ph.D. Programmes
(Mathematics, Computer Science, Physics)

Eligibility

- *Ph.D. in Mathematics*: 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.
- *Ph.D. in Computer Science*: 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.
- *Ph.D. in Physics*: Students with an M.Sc. degree in Physics and students with a bachelors degree in Physics or Engineering with a strong aptitude for research.

Admission Admission is through an entrance examination to be conducted at centres throughout the country on **Thursday, May 15, 2014**, followed by an interview in Chennai. Details about the admission procedure are available at `http://www.cmi.ac.in/admissions`.

Fees and scholarships Research Scholars get a stipend of Rs 16000 per month for the first two years and Rs 18000 per month for the next three years, along with an annual book grant of Rs 10000. 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 1–2 years 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 organizations. 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

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5. Prof. Madhavan Mukund,
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