Chennai Mathematical Institute

National Undergraduate and Postgraduate
Programmes in Mathematical Sciences

Information Brochure, 2017–2018

3-Year B.Sc. (Honours) Programme in Mathematics and Computer Science
3-Year B.Sc. (Honours) Programme in Mathematics and Physics
2-Year M.Sc. Programme in Mathematics
2-Year M.Sc. Programme in Computer Science
2-Year M.Sc. Programme in Applications of Mathematics
Ph.D. Programme in Mathematics
Ph.D. Programme in Computer Science
Ph.D. Programme 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 the 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 from 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, in Computer Science and in 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 programme 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. programmes. 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 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 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

The undergraduate programme includes two compulsory Humanities courses. Electives are offered in areas such as literature, economics, art and music. The CMI Arts Initiative organizes regular cultural programmes and seminars throughout the year and supports an international writers' residency in collaboration with Sangam House, Bangalore.

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 faculty and students. Each year, top-ranking senior B.Sc. students from CMI spend the summer at ENS working on research problems with faculty there. Members of ENS also visit CMI regularly to participate in research and teaching.

The Institute also has a formal agreement with the École Normale Supérieure Paris-Saclay in Cachan, France, for exchange of B.Sc. and M.Sc. students and for a joint Ph.D. programme.

From 2017, CMI is part of an international joint research unit (UMI) in Computer Science under the French National Centre for Scientific

Research (CNRS), which also provides opportunties for exchanges of students and faculty with French partners in the UMI.

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, Cornell, Harvard, MIT, Princeton, Stanford, 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. More recently, several CMI students have founded startups in India and in the USA.

CMI has set up a separate society called Algolabs to promote interaction between CMI and the industry. Algolabs undertakes training programmes and projects in areas such as analytics, optimization and risk management and provides opportunities for faculty and students to engage with industry on real-life applications of mathematical sciences.

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. Beginning August 2017, the charges will be Rs. 23,800 per semester, (Rs. 4,000, Rs. 16,800 and Rs. 3,000 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). Since 2014, CMI has also received support from 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 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. The Infosys Foundation contributed a large corpus to CMI in 2014. 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 2017, 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, 18th May 2017**. 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 a three-year course. The following is the semester-wise schedule of courses.[1]

Semester I	**Semester II**
Algebra I	Advanced Programming
Analysis I	Algebra II
Humanities I (English)	Analysis 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
Analysis III
Design and Analysis of Algorithms
Calculus
Theory of Computation

Semester IV

Complex Analysis
Differential Equations
Programming Language Concepts
Topology
Elective I

Semester V

Elective II
Elective III
Elective IV
Elective V

Semester VI

Humanities II
Elective VI
Elective VII
Elective VIII

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

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

Semester I

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

Semester II

Algebra II
Analysis II
Probability Theory
Classical Mechanics II
Electrodynamics I

Semester III

Algebra III
Analysis III
Calculus
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**
Elective I	Humanities II
Elective II	Elective V
Elective III	Elective VI
Elective IV	Elective VII

Of the seven elective courses, one must be a laboratory course. 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 2017, undergraduate degrees such as B.A., B.Sc., B.Math., B.Stat., B.E., 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, 18th May 2017**, 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. Part of the course-work for the MSc Mathematics programme is concurrent with the PhD Mathematics programme.[3]

Semester I	**Semester II**
Graduate Algebra I	Graduate Algebra II
Graduate Analysis I	Graduate Analysis II
Graduate Topology I	Graduate Topology II
Introduction to Manifolds	Complex Analysis

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

Semester III	**Semester IV**
Directed Reading	MSc Thesis
Elective I	Elective III
Elective II	Research Seminar
Research Seminar	

The MSc Thesis in the final semester is equivalent to two regular courses. At the discretion of the Board of Studies, 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.

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 2017, undergraduate degrees such as B.A., B.Sc., B.Math., B.Stat., B.E., B.Tech., ... 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, 18th May 2017**. 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 five core courses and a project/dissertation. The list of courses in the programme is given below.[4]

1. **Core courses**

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

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

2. **Electives**

   The elective courses that have been offered at CMI in recent years include:

   Approximation Algorithms, Automata Theory and Verification, Coding Theory, Complexity Theory, Computational Geometry, Concurrent Programming, Cryptography and Security, Data Mining and Machine Learning, Digital Systems Design and Modelling, Discrete Mathematics, Finite Model Theory, Logical Foundations of Databases, Model Checking and Systems Verification, Optimization, Probability and Statistics, Program Analysis, Quantitative Automata Theory, Randomized Algorithms, Theorem Proving

   The exact list of elective courses being offered will be announced at the beginning of each semester.

3. **Project/Dissertation**

The project/dissertation is equivalent to four regular courses. At the discretion of the Board of Studies, 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/teaching`.

M.Sc. Programme in Applications of Mathematics

Admission and eligibility Students who have obtained, or expect to obtain in 2017, undergraduate degrees such as B.A., B.Sc., B.Math., B.Stat., B.E., B.Tech., ... with a 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, 18th May 2017**, 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

Two streams are offered at present, Financial Mathematics and Analytics. A student must complete 16 courses over a period of four semesters, comprising a set of core courses and electives. 3–4 electives may 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	Stochastic Processes I
Analysis	Finance
Probability and Statistics	Design and Analysis of Algorithms
Programming Techniques	Economics

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

Core courses, second year

1. Econometrics I
2. Econometrics II
3. Mathematical Finance
4. Financial Risk Management

Analytics

Core courses, first year

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

Core courses, second year

1. Theory of Computation
2. Data Mining and Machine Learning
3. Time Series Analysis
4. Regression Classification
5. Multivariate Statistics

Elective courses (both streams)

1. Stochastic Processes II
2. Measure Theoretic Probability
3. Differential Equations
4. Computational Methods
5. Simulation Methods
6. Risk Management
7. Randomized Algorithms
8. Algorithms on Strings, Trees and Sequences
9. Cryptography and Security

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, 18th May 2017**, followed by an interview in Chennai. Details about the admission procedure are available at `http://www.cmi.ac.in/admissions`.

Courses and research Students admitted to the Ph.D. programme are expected to complete 1–2 years of compulsory course work. There is also a qualifying examination, to be taken within the first two years. Continuation in the programme is contingent on performance in the Ph.D. courses and the qualifying examination.

After passing the qualifying examination, students are assigned guides and begin their research work. Their progress is monitored periodically by a doctoral committee.

Fees and scholarships Research Scholars get a stipend of Rs 25000 per month for the first two years and Rs 28000 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.

At the discretion of the Admissions Committee, students with a B.Sc. degree and those switching subjects may be admitted as Pre-Ph.D. students. For the first two years, Pre-Ph.D. students will be enrolled as a regular M.Sc. students in the corresponding subject. Till they complete

their M.Sc. coursework or pass the Ph.D. qualifying examination, Pre-Ph.D. students will receive a reduced scholarship, but will be eligible for other benefits similar to regular Ph.D. students.

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
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Chennai Mathematical Institute,
Academic Council

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