

B.Tech in Mathematics and Computing @ IIT Hyderabad

The inception of the program. The B.Tech Mathematics and Computing undergraduate program started in the academic year 2017-2018 with 10 students. The number of seats has been increased to 20 from the academic year 2020-21.

The curriculum of the program at a glance.

The curriculum is designed in a unique way to nurture future industry professionals and scientists. There are three stages of the curriculum. Students do introductory mathematics, physics, chemistry, life sciences, and bio-engineering courses in the first stage. The program also begins with programming and skill development courses such as English communication, introduction to entrepreneurship, artificial intelligence, and creative arts electives.

The second stage is a phase of nurturing students to make them multiskilled for both industry and academics. During the 3rd to 5th semester, the program covers the core foundational courses from pure mathematics, applied mathematics, statistics, and computing courses from computer science, artificial intelligence, and electrical engineering. The blend of theoretical, applicable, and computing courses is carefully chosen to enable students to choose the career they wish to pursue.

The third stage is all about exploration. The career students have decided to pursue by the end of the second stage begins in the 6th semester. The exploratory nature comes from the fact that 38 credits out of 46 credits in the 6th to 8th semester come in the form of electives. While half of the credits are for advanced mathematics and computational mathematics electives, students will still have 12 credits of free elective courses to choose from other departments in the institute. The students can choose a semester-long Industry project in the 6th semester. Department also offers credited research projects for two semesters in this stage, up to 6 credits

Upon successfully completing the Mathematics and computing program, students will be able to pursue their dream of being industry professionals. This program also provides an opportunity for higher education in mathematics, computer science, artificial intelligence, etc. in world-class universities.¹

¹*“From the start, there has been a curious affinity between mathematics, mind, and computing. It is perhaps no accident that Pascal and Leibniz in the seventeenth century, Babbage and George Boole in the nineteenth, and Alan Turing and John von Neumann in the twentieth seminal figures in the history of computing were all, among their other accomplishments, mathematicians, possessing a natural affinity for symbol, representation, abstraction, and logic” .*

Doron Swade, Museum curator and author, History of Computing.

Mathematics and Computing career:

Industry Professionals <ul style="list-style-type: none">● Networking● Optimization● Statistical Analysis● Logistics● Math Modeling of real-life scenarios from Aerospace to Epidemics	Teaching and research career <ul style="list-style-type: none">● To nurture students for pursuing higher education in the reputed institutions in India and abroad on the following topics<ul style="list-style-type: none">- Mathematics- Computer Science, and- Related topics
---	---

Mathematical aspects of M&C <ul style="list-style-type: none">● Mathematics is fun and challenging● The subject is logical and creative● Important for applications● Develops abstract thinking	Computational aspects of M&C <ul style="list-style-type: none">● Faster convergence● Efficient algorithms● Clear worst-case guarantees● Develops application-based skills
---	---

Why Mathematics and Computing?

<ul style="list-style-type: none">● Mathematics gives theoretical guarantees● Mathematics shows the direction● Mathematics lets you model● Mathematics empowers you to propose● Math endows elegance	<ul style="list-style-type: none">● Computing knows its bounds.● Computing charts the path.● Computing allows you to demonstrate.● Computing enables you to verify.● Computing sanctions efficiency.
--	--

B.Tech M&C curriculum 2022

Stage 1 (Semester I and II). The first stage is designed to build your skills and knowledge of basic maths and sciences.

Mathematics

Calculus I and II
Foundation of Math
Combinatorics
Elementary Linear Algebra
Differential Equations
Series of Functions
Introduction to Number Theory

Basic Sciences

Modern Physics
Physics Lab
Environmental Chemistry
Introduction to Life Sciences

Skill-based courses

Introduction to Programming
English communication
Introduction to Entrepreneurship
Artificial Intelligence
Creative Arts Electives

Stage 2 (Semester III to IV). The second stage will cover the core foundational courses from pure mathematics, applied mathematics, statistics, and computing courses. This stage also contains one free elective of 3 credits in the 5th semester to be chosen by students as per interests.

Mathematics

Linear Algebra
Probability Theory
Transform Techniques
Introduction to Metric Spaces
Complex Variables
Ordinary Differential Equations
Applied Statistics
Real Analysis
Algebra I - Groups and Rings
Data Structures & Applications Lab

Computer Science

Data Structures & Applications
Algorithms
Theory of Computation
DBMS 1
Operating Systems I

EE and AI

Digital Circuits
Linear Systems & Signal
Processing
Convex Optimization

Stage 3 (Semester VI and VIII). The third stage mainly contains electives and the option of research projects and industrial projects. The personality development course has been placed just before the placement begins.

Type of electives and credit distributions. The aim of providing elective courses is to support the interests of students rather than fixing courses. MA electives and MA computational electives are to be chosen from the courses offered by the mathematics department. The allotted number of credits of each type is fixed as of now. However, students can opt for an Industry project worth 6 credits in the sixth semester and credited research projects worth 6 credits from the departmental electives. Students are encouraged to use free electives to register for courses of their interests from any department in the institute.

Type of electives	Credits
MA Electives	12
MA Computational Electives	12
Free Electives	9
Liberal Arts/Creative Arts	5
Industry Project	6
Credited Research Project	6

A Sample of Elective Baskets.

MA Electives

The Theory of Polynomials
Diophantine Equations
Complex Analysis
Introduction to Modern Number Theory
Introduction to Analytic Number Theory
Algebraic Number Theory
Representation Theory
Partial Differential Equations
Modules and Fields
Commutative Algebra
Combinatorial Commutative Algebra
Homological Algebra
Banach Algebra
Operator Theory
Positive Definite Matrices
Fourier Analysis and Applications
Advanced Measure Theory
Convex Functions and Their Applications
Measure and Integration
Measure Theoretic Probability
Sets, Logics and Boolean Algebra
Fuzzy Logic Connectives and Their Applications
Topology
Introduction to Algebraic Topology
Differential Topology
Curves and Surfaces
Differential Geometry
Introduction to Algebraic Geometry
Algebraic Geometry I
Algebraic Geometry II
Algebraic Coding Theory

MA Computational Electives

Linear Programming
Numerical Linear Algebra
Mathematics Behind Machine Learning
Introduction to Regression and Multivariate Analysis
Statistical Inference
Statistical Analysis using R
Basic Cryptography
Computational algebra on polynomials and ideals
Introduction to Time Series Analysis
Design of Experiments
Non-parametric Inferences
Coding Theory on Algebraic curves
Compressed Sensing
Mathematical Methods
Applied Functional Analysis
Wavelets and Applications
Advanced Programming
Statistical Reliability Theory
Introduction to Bayesian Statistics
Introduction to Lattice Theory
Searching in Metric Spaces
Probability Theory in Finance
Introduction to Stochastic Calculus
Finite fields and their Applications
Biomechanics
Principles of biostatistics
Applied and computational complex analysis
Vortex dynamics
Mathematical fluid dynamics

Projects taken up by M&C students in the recent past:

Core ML <ul style="list-style-type: none">● Extrapolations in Adaptive Bayesian Optimization.● Effect of High Dimensions on Kernels.● User Return Time Prediction in Recommendation Systems.	Statistics <ul style="list-style-type: none">● Cluster Randomized Designs for Binary Responses● Gaussian Mixture models in survival data analysis
---	---

Deep Learning <ul style="list-style-type: none">● Human Path Prediction using Social LSTMs● Sparse Adversarial Attacks in Machine Learning● Attacking the Intelligence of Neural Nets By pruning vulnerable filters	CS <ul style="list-style-type: none">● LVM and SHM Mapping Kernel Driver● Concurrency Based Chat Server● Crypto-primitives using Multivariate Ideal Lattices
--	---

Finance <ul style="list-style-type: none">● Time Series Analysis of NSE Stock Prices● Risk Return Relationship : Linear or NonLinear Trade off?	
---	--

Frequently Asked Questions (FAQs)

1. What were the opening and closing ranks in this program last year?

See the link: <https://math.iith.ac.in/academics/btech>

2. Is B.Tech (M&C) the same as B.Tech (CSE) at IITH?

Well, the answer is a clear **NO**. While computing does require knowledge of the fundamental courses of CSE, the focus of the M&C program is on doing the mathematics and essential programming and computational courses.

3. Is B.Tech (M&C) the mix of B.Tech (CSE+ AI + EE) at IITH?

The answer is a clear **NO**. The mathematics courses constitute the major component of this curriculum. Besides mathematics, M&C students do standard introductory engineering, programming, and AI courses. Students are encouraged to use free electives to register for courses of their interests. Moreover, a student maintaining a good CGPA will be allowed to take additional courses.

4. What are the higher education opportunities after B.Tech (M&C)?

This program provides an excellent opportunity to learn theoretical and computational mathematics to pursue higher education in mathematics, computer science, artificial intelligence, etc., in world-class universities.

5. Are options like "branch change" or "double major/minors" in an allied engineering stream" still available?

Branch change, No.

Double major or Minor, Yes

6. Will there be good placements for the students of this stream?

See the placement data here: <https://math.iith.ac.in/achievements/placements>