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 courses on programming and skill development 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 so as to enable students to choose the career they wish to pursue.

The third stage is all about exploration. The dream career that students have decided to pursue by the end of the second stage begins from the 6th semester. The exploratory nature comes from the fact that 38 credits out of 46 credits from the 6th to 8th semester come in the form of electives. While half of the credits are of advanced mathematics and computational mathematics electives, students will still have 12 credits of free elective courses to choose from any of the departments in the institute. The students have an option of 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]

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[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	Teaching and research career
- Networking - Optimization - Statistical Analysis - Logistics - Math Modeling of real life scenarios from Aerospace to Epidemics	To nurture students for pursuing higher education in the reputed institutions in India and abroad on the following topics - Mathematics - Computer Science, and - Related topics

Mathematical aspects of M&C	Computational aspects of M&C
- Mathematics is fun and challenging - The subject is logical and creative - Important for applications - Develops abstract thinking	- Faster convergence - Efficient algorithms - Clear worst-case guarantees - Develops application-based skills

Why Mathematics and Computing?

- Mathematics gives theoretical guarantees - Mathematics shows the direction - Mathematics lets you model - Mathematics empowers you to propose - Math endows elegance	- 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 2020

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
Bioengineering

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 industry projects. The personality development course has been placed just before the placement begins. The fixed courses in this stage are below one

Mathematics	Computer Science	Liberal Arts
Multivariable Calculus Functional Analysis	Compilers-I	Personality development

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

MA Computational Electives

Linear Programming
Numerical Linear Algebra
Mathematics Behind Machine Learning
Regression Analysis
Statistical Inference
Statistical Analysis using R
Basic Cryptography
Computational algebra on polynomials and ideals
Time Series Analysis
Design of Experiments
Non-parametric Inferences
Algebraic Coding Theory
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

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

Core ML	Statistics
- Extrapolations in Adaptive Bayesian Optimization. - Effect of High Dimensions on Kernels. - User Return Time Prediction in Recommendation Systems.	- Cluster Randomized Designs for Binary Responses - Gaussian Mixture models in survival data analysis

Deep Learning	CS
- Human Path Prediction using Social LSTMs - Sparse Adversarial Attacks in Machine Learning - Attacking the Intelligence of Neural Nets By pruning vulnerable filters	- LVM and SHM Mapping Kernel Driver - Concurrency Based Chat Server - Crypto-primitives using Multivariate Ideal Lattices

Finance	
- 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?

Opening and Closing Ranks 2019			
Category	**Seat Pool**	**Opening Rank**	**Closing Rank**
OBC-NCL	Gender-Neutral	307	472
OBC-NCL	Female-Only	1656	1656
GEN-EWS	Gender-Neutral	93	93
OPEN	Gender-Neutral	661	694
OPEN	Female-Only	2129	2129
OPEN (PwD)	Gender-Neutral	102	102
SC	Gender-Neutral	389	389
ST	Gender-Neutral	238	238

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. The program aims to nurture multi skilled professionals for both industry and academics.

There are 15 credits of CSE core courses in the curriculum. Students interested in CSE courses can make use of free electives worth 12 credits for the same. Moreover, a student maintaining a good CGPA will be allowed to take additional courses as per their interest.

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

The answer is a clear **NO**. Besides mathematics, M&C students do standard introductory engineering courses, programming courses, and AI courses. The core curriculum has computation and programming components CSE (15 credits), EE (6 credits), and AI (5 credits).

In addition to the above, students have 12 credits of free electives. Students are encouraged to use free electives to register for courses of their interests from any department in the institute. Moreover, a student maintaining a good CGPA will be allowed to take additional courses as per their interests.

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

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

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

Yes. As per the prevailing norms of the institute, a student is permitted to avail of branch change, minor or double major in an allied stream

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

We expect students will get good placements. Note that the Department of Mathematics started the B. Tech in Maths and Computing program in the year 2017-18 with a batch size of 10. The first batch is all set to graduate in the academic year 2020 - 21.

The placement session for the first batch is scheduled in December 2020. We are glad to announce that 3 of our students have already received pre-placement offers (PPOs) from the companies - Goldman Sachs, Microsoft (as of 27th September 2020).