

*“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*

## **B.Tech (Mathematics and Computing)**

# B.Tech (Math & Computing) @ IITH

## Inception

- Started in the academic year 2017-18
- Current Strength : 10

## Mission

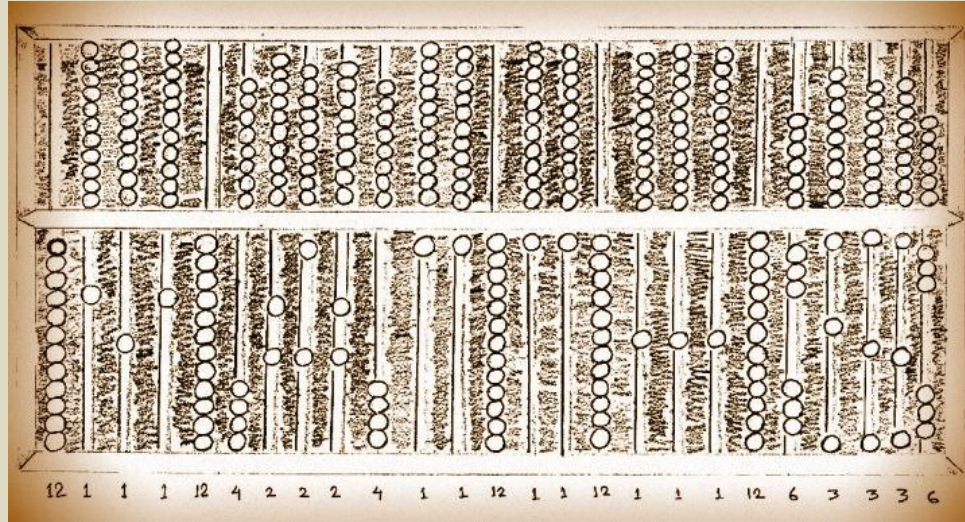
To equip the students with the mathematical foundations required to excel in various applied and computational streams where Math plays a major role.

## Vision

To produce engineers whose

- Hands are in practice,
- Head in theory, and
- a Heart to act as a bridge between the two.

# Why Mathematics & Computing?



- Math gives theoretical guarantees .... so that Computing knows its bounds.
- Math shows the direction ... Computing charts the path.
- Math lets you model ... Computing allows you to demonstrate.
- Math empowers you to propose ... Computing enables you to verify.
- Math endows elegance ... Computing sanctions efficiency.

# About B.Tech M&C @ IIT Hyderabad

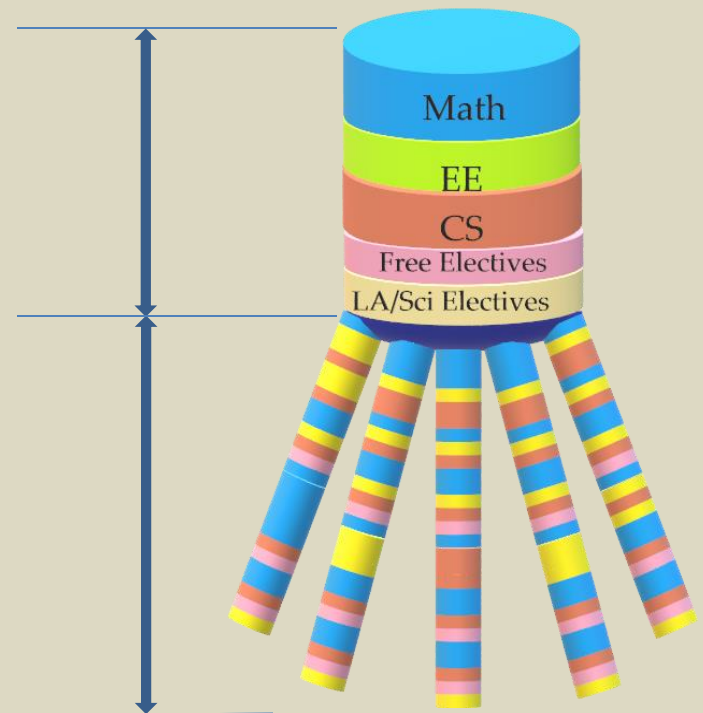
## The RAKE Model

### First 4 semesters

- Foundational courses from Math, CS and EE
- Free electives from Science, Liberal Arts and Other Engineering Streams
- More Core credits than Elective Credits

### Next 4 semesters

- More Elective credits than Core Credits
- Higher Level Math courses
- Electives can be chosen from different baskets
- Appropriate courses from the Math Basket to supply the required back ground
- Mix-and-Match courses to form a Track



# Why B.Tech M&C @ IIT Hyderabad?

## Depth

- Around 50 credits of foundational Math, CS and EE in the first 4 Semesters.
- A wide range of Math electives that supplies the advanced concepts required for the courses in computational engineering baskets.

## A Sample of the Foundational Courses

### CS

- Data Structures
- Computer Architecture
- Complexity Theory
- Principles of Programming
- Theory of Computation
- Algorithms
- DBMS
- Computer Networks
- Operating Systems

### Math

- Calculus
- Matrix Theory
- Probability
- Transforms
- Linear Algebra
- Complex Variables
- Statistics
- Numerical Analysis
- Differential Equations
- Optimisation

### EE

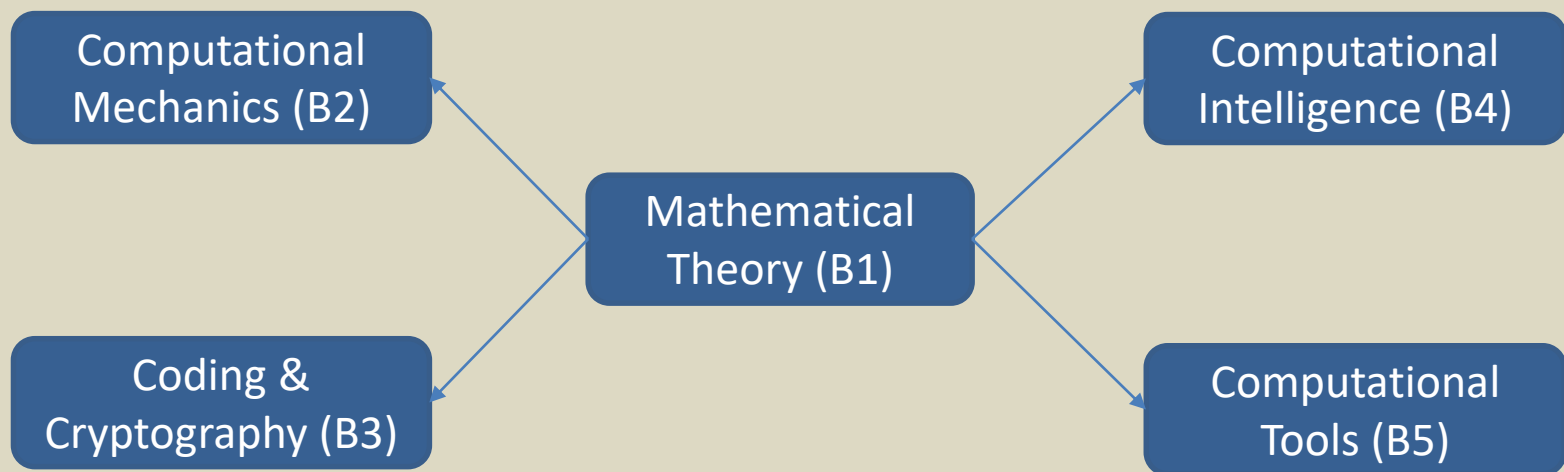
- Digital Design
- Embedded Programming
- Digital Signal Processing
- Internet of Things
- Control Theory
- Information Sciences
- Artificial Intelligence
- Random Processes

# Why B.Tech M&C @ IIT Hyderabad?

## Variety

- 27 Credits of Math and 12 Credits of Free Electives in the last 4 semesters.
  - To be chosen from different computational engineering baskets.

### A Sample of the Elective Baskets



# Why B.Tech M&C @ IIT Hyderabad?

## Flexibility

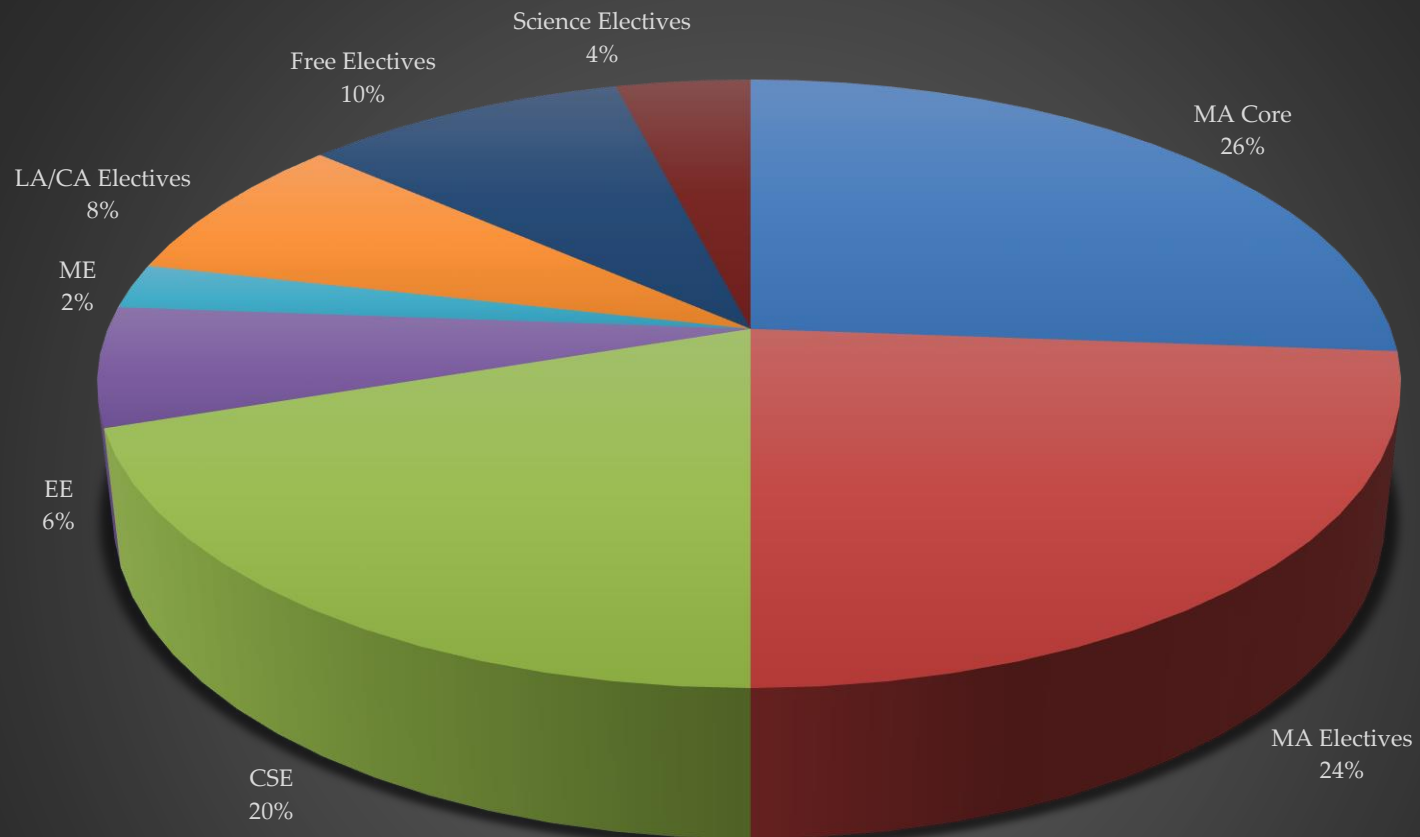
- Freedom to mix and match courses from different baskets.
- Pick appropriate courses that complement the electives in a computational engineering basket with the required Math rigour.

## A Sample Track in Computational Intelligence\*

|   |  |
|---|--|
| <b>Semester 5</b><br>Numerical Linear Algebra (B1)<br>Bayesian Data Analysis (B4)<br>Intro to Machine Learning (B4)                   | <b>Semester 7</b><br>Functional Analysis (B1)<br>Measure Theoretic Probability (B1)<br>Optimization for ML (B4)              |
| <b>Semester 6</b><br>Convex Optimization (B1)<br>Measure Theory (B1)<br>Math Behind Machine Learning (B1)<br>Pattern Recognition (B4) | <b>Semester 8</b><br>Statistical Learning Theory (B4)<br>Sparse Representation Theory (B4)<br>Advanced Machine Learning (B4) |

\*The Sample Track is for illustration purpose only.

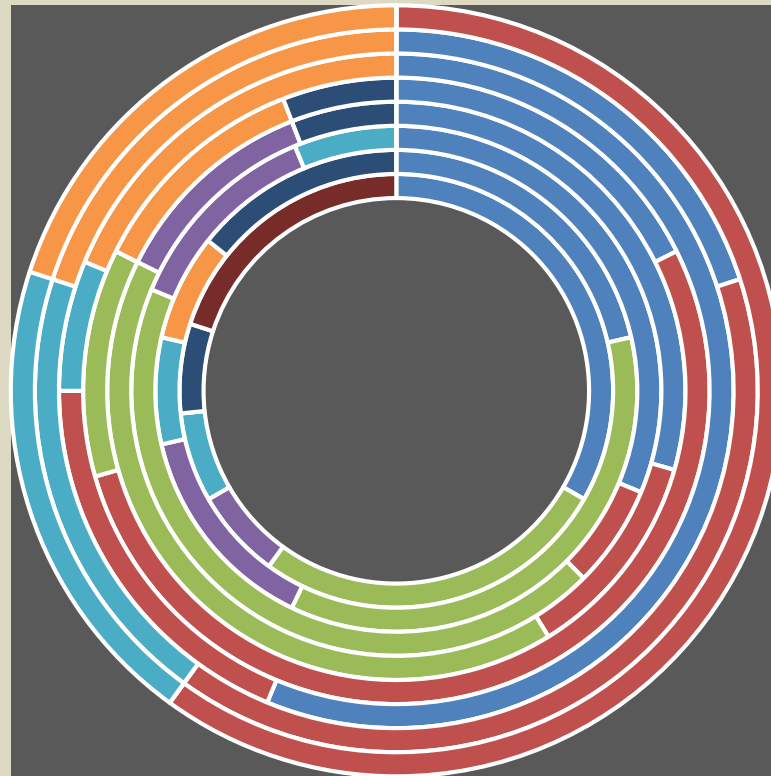
# Overall Credit Distribution



■ MA Core ■ MA Electives ■ CSE ■ EE ■ ME ■ LA/CA Electives ■ Free Electives ■ Science Electives



# Semesterwise Credit Distribution



■ MA Core ■ MA Electives ■ CSE ■ EE ■ ME ■ LA/CA Electives ■ Free Electives ■ Science Electives

- Each concentric circle denotes a semester.
- Greater the radius higher the semester.

# Expected Outcomes ...

- To understand the role of Math in Computational Sciences.
- To obtain a strong Math foundation that is both relevant and current.
- To apply such acquired knowledge to solve real-world computational problems.
- To visualize and model complex problems.
- To analyze and optimize hitherto constructed models.
- To gain proficiency in state-of-the-art computational tools.

# Mathematics in Computing ...

*“Separation from mathematics **no longer makes sense** ...  
Computing advances have run their course ... Fundamental  
roadblocks are **only** Mathematical ... Payoffs are large and  
widespread – both for the society & Math.”*

- David Donoho, *Stanford University*  
*Math Challenges of the 21<sup>st</sup> Century, 08.08.2000*



For more info on B.Tech (Math & Computing), please see ...

[http://math.iith.ac.in/Academics/btech\\_mnc.html](http://math.iith.ac.in/Academics/btech_mnc.html)