

Indian Institute of Technology Hyderabad
Department of Computer Science and Engineering

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Syllabus for MTech Admission

We will use the same syllabus for both the written tests and interviews. However, please note that in the interview we may ask questions from your research area that are not covered in the syllabus given here. The syllabus is nearly identical to the GATE CS syllabus. However, we have listed some of the topics in detail.

Data Structures and Algorithms:

- **Data structures:** arrays, stacks, queues, recursion, linked lists, binary trees, binary search trees, min/max heaps, graphs, searching, sorting, and hashing.
- **Algorithms:** asymptotic notations, time and space complexity, divide and conquer, greedy method, dynamic programming, graph traversals, minimum spanning trees, and shortest paths.

Programming: Basic programming knowledge in C/C++.

Probability, Linear Algebra, and Discrete Mathematics:

1. **Discrete Mathematics:** Propositional and first-order logic. Sets, relations, functions, partial orders, and lattices. Monoids, Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.
2. **Linear Algebra:** Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.
3. **Probability and Statistics:** Random variables. Uniform, normal, exponential, Poisson, and binomial distributions. Mean, median, mode, and standard deviation. Conditional probability and Bayes theorem.

Follow the GATE CS syllabus from [this link](#) for the following topics:

- | | |
|-------------------------------------------|-----------------------|
| 1. Digital Design | 4. Compiler Design |
| 2. Computer Organization and Architecture | 5. Operating System |
| 3. Theory of Computation | 6. Databases |
| | 7. Computer Networks. |

How do you need to prepare for the written test?

The majority of the written test questions (60%) will cover data structures, algorithms and discrete mathematics. However, the remaining questions will be based on the GATE CS syllabus. Written tests will consist of multiple-choice questions. However, we may ask you certain subjective questions. These subjective questions will not be used to shortlist candidates for an interview. However, your method of answering these questions will be discussed during the interview.

How to Prepare for Interviews?

Only for Research Assistant (RA) and Government/Industry Sponsored Candidates

Do you need to prepare?

Yes, preparation is required to clear the interview! Unfortunately, most of the candidates who appear for the interviews do not seem to understand how to prepare for these interviews. By preparation, we do not mean just “reading” through the textbooks and recalling the definitions. You should have understood the concepts rigorously, have thought about them critically, and be able to solve problems related to these concepts intelligently.

What do we expect from an applicant?

We expect that the candidate has a thorough understanding of the concepts in core computer science subjects like Data Structure and Algorithms (DSA), Programming (C/C++/Java/Python), Operating Systems, Computer Architecture, Networking, DMBS, Probability, etc. We ask conceptual questions that require you to not simply recall the material you have read but use the concepts to solve problems. This applies to both written tests and interviews.

If you were involved in a research project then we expect that you will be able to explain the work that you have done.

Don't Dos:

- *“I have forgotten the concepts of DSA because I have studied them a long time back”* — Please note that you have to revise the concepts before the interview.
- *“I was involved in this project but I don't remember what I have done”* – If you were actively involved in a recent project you should be able to answer questions related to it.
- *“I didn't get enough time to prepare after you sent the call letter for the interview”* - You should start your preparation well in advance.
- *“I forgot programming because I have not practiced it for a long time”* – We expect that you should know the fundamentals of at least one programming language like C/C++/Python/Java.

How do we give weightage to your published research paper?

Please note that your in-depth understanding of core CS subjects is the first and foremost thing we will check. If you have good publications then they will add significant weightage to your application but if you fail to answer questions in the core subjects your application will be rejected. Another important point to note is that we have internal standards for deciding the quality of a published paper. Your published paper has to be published in a reputed journal or conference. *One way to determine the ranking is to see if the journal is ranked Q1/Q2 by SCIMAGO and if the conference is ranked better than a C by CORE conference ranking portal. Note that rankings by these portals are not always accurate but they give you a general idea of what we mean when we say “reputed”.*

Does the emphasis on core CS subjects mean that research experience is not important?

Research experience and publications will add significant weight to your application but the first and foremost eligibility criterion that we will be looking for is if you have a clear understanding of core CS concepts, especially those underpinning the area that you will be working in later. For example, if you want to work in ML we expect that you can answer conceptual questions from subjects like Probability, Linear Algebra, Computer Programming, DSA, etc. If you want to work in theoretical computer science, we expect that you can answer questions by applying concepts from DSA, Algorithms, Discrete Mathematics, Probability, etc. A candidate who wants to do research in computer systems should be able to solve problems in DSA, Computer Programming, Operating Systems, Networking, Computer Architecture, Compilers, DBMS, etc. You may not have prepared to answer questions from all these subjects but you should be ready to take questions from at least a few of them.

What is the weightage given for the ranking of your UG/PG university/college?

We do not consider the reputation/ranking of your UG/PG institutions in the written test or interview. The only thing we evaluate is how well you can think critically and apply the concepts you have learned to solve problems. However, there may be relaxation in the shortlisting criteria for students who have graduated from IITs, NITs, and other CFTI institutes.

To summarize,

We want candidates with an in-depth understanding of concepts in core CS subjects who can apply these concepts to solve problems.

Sample Interview Questions

Data Structures:

1. Given a binary tree, how do you determine if the tree is a binary search tree?
2. Implement a first-in first-out (FIFO) queue using only two stacks. The implemented queue should support all the functions of a normal queue. **Follow up:** Can you implement the queue such that each operation is amortized $O(1)$ time complexity?
3. How do you convert a max heap into a min-heap?

Discrete Structures:

1. Prove that for every positive integer N , there are N consecutive composite integers.
2. Show that given any 17 numbers it is possible to choose 5 whose sum is divisible by 5.

Probability and Linear Algebra

1. When you throw a dice two times, the probability that the second number is greater than the first?

2. Let A be an $N \times N$ square matrix. What can we say about the rank of a matrix if the determinant of A is 0?

Computer Networks

1. How would a layer-3 router find a possible link failure in the rest of the network?
2. How does a TCP sender infer packet loss in the network?

Computer Architecture:

1. What is a data hazard in pipelining? How forwarding can reduce the overhead of data hazard? Can you give an example, in terms of RISC-V ISA, when forwarding cannot resolve the issues of data hazard?
2. What is the difference between capacity misses and conflict misses in terms of cache memory?

DBMS:

1. Give an example of BCNF decomposition which does not preserve functional dependencies.
2. What is the advantage of clustered indexing over non-clustered indexing?
3. Explain a technique to implement natural join between two tables $T1$ and $T2$ when both the tables are sorted on the common attributes.

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All the best!!

For any other queries, please contact, MTech Admission Committee, Department of CSE, IIT Hyderabad, Kandi, Sangareddy, 502284, mtech.admissions@cse.iith.ac.in