

# **Master of Technology in Computer Science and Engineering**

**Master of Technology in Computer Science and Engineering  
with Specialization in Systems Engineering**

**Master of Technology in Computer Science and Engineering  
with Specialization in Intelligent Systems**



<b>Programme Level</b>	Post Graduate
<b>Year of Commencement</b>	2021
<b>Minimum Duration</b>	2 Years (4 Semesters)
<b>Maximum Duration</b>	3 Years (6 Semesters)
<b>Senate Reference</b>	30.8/31.10

School of Computing and Electrical Engineering

## **1. Name of the Degree Program**

Master of Technology in Computer Science and Engineering

Master of Technology in Computer Science and Engineering with Specialization in Systems Engineering

Master of Technology in Computer Science and Engineering with Specialization in Intelligent Systems

## **2. Abbreviation**

Master of Technology is abbreviated as M.Tech.

## **3. Eligibility**

1. Candidates who have qualified for the award of a Bachelor's degree in Engineering (B.E.) / Technology (B.Tech.) or equivalent from a recognized University/Institute with minimum 60% (or 6.0 CGPA), and who have qualified and have a valid score in Graduate Aptitude Test in Engineering (GATE) in Computer Science and Engineering are eligible to apply for admission to this program.
2. For all B.Techs from IITs graduated with a CGPA of 8.0 or above, the requirement of GATE qualification is waived off.
3. Students sponsored by a recognized R&D organization, academic institution, government organization, or industry are eligible to apply for this program on a full-time basis. The Institute does not provide any assistantship to such students.
4. A candidate with Associate Membership of Professional Bodies equivalent to B.Tech., as approved by the Senate of IIT Mandi and having valid GATE score in CSE shall also be eligible to apply for admission to this program with an assistantship, subject to regulations approved by the Senate.
5. For more details on eligibility criteria please refer to ordinance and regulations for M.Tech./M.Sc. of IIT Mandi.

## **3. Duration**

The duration of this program is two years. Each year consists of two semesters, summer and winter terms.

## **4. Credits to be Earned**

The students have to earn a minimum of 70 credits for the degree of Master of Technology in Computer Science and Engineering, with or without the specializations, as per the credit distribution details given under "Program Details".

## **5. Campus Stay**

Students admitted to these degree programs are required to stay on campus and to participate and complete all requirements of the program, except if they choose to undertake the exploratory work outside the institute during first winter vacation, as described in Section 4 under "Program Details".

All other details are in accordance with the ordinance and regulations for M.Tech/M.Sc of IIT Mandi (see <http://iitmandi.ac.in/academics/files/Ordinances-for-M.Tech-M.Sc.pdf>).

# Program Details

## 1. Preamble to the Program

Over the last two decades, the discipline of Computer Science and Engineering (CSE) has grown enormously. CSE is now a bridge discipline that enables working in other scientific disciplines as well. Although a four-year BTech curriculum introduces a student to the various facets, it is imperative that the student be trained in the advanced developments in certain areas and be practically familiar with various applications of the same in industry and research.

The two-year MTech program in Computer Science and Engineering at the Indian Institute of Technology Mandi is proposed to (a) teach the theory and practice behind certain core as well as advanced areas, in the form of courses and labs; (b) impart the ability to work on and take ahead large applications in industry and research, in the form of a project; (c) give them an exposure to other disciplines in the form of elective courses

The degree would be awarded upon successful completion of the credit requirements for the course work and satisfactory performance in a (year-long) project. The minimum CGPA requirement would be as per the prevailing norms of the institute.

## 2. Program Objectives

- To equip students with a good understanding of the basics and the latest developments in computer science and engineering for a successful career in academia or industry.
- To produce technically well-rounded professionals to cater to the growing demand for such professionals for research and development in various areas of computer science and engineering.

## 3. Specializations Offered

- Systems Engineering
- Intelligent Systems

## 4. Credit Structure

- The minimum number of overall credits required to be completed is 70, out of which 41 credits will be fulfilled using course work, 3 credits using exploratory work during winter term (*after 1st semester*), and 26 credits using the postgraduate project (PGP).
- The course work would be divided into three categories: (i) core courses (11 credits) from a basket of suggested courses that each student is expected to complete; (ii) discipline electives (20 credits) that need to be taken from the relevant PG level courses (as listed in Section 5); and (iii) outside discipline electives (9 credits) that can be taken from any school of the institute. An overview of the proposed core courses is given in Section 4.
- **Exploratory work.** 3 credits of exploratory work during winter break (*after 1st semester*) would be graded in a Pass/Fail manner. For this, the student can either work with a faculty member of the institute, or go for an internship at an industry or another reputed academic institution. In case of an internship, the student will not be paid fellowship for the duration of the winter break. The evaluation of this component would be made based on a 30-minute presentation that the student would have to make to the primary advisor (local or external) for the exploratory work, along with another faculty member of the institute who works in related areas.

- **Postgraduate project.** The postgraduate project (PGP) starts from the summer following the first year and extends to the third and fourth semesters. The student would be allotted a guide to work on the PGP before the beginning of the third semester. There will be a committee to monitor the progress of the student in the project each semester and accord a grade for the project.
- **Specialization.** Students pursuing at least Core courses mentioned in below table + 12 discipline elective credits in a specific stream (systems engineering or intelligent systems) with a 7.5 GPA in those courses (minimum C in each such course) and whose PGP is in the same area would be eligible to get a specialization in the corresponding stream. Students who meet these requirements could thus get an M. Tech. in Computer Science and Engineering with an option for specialization in systems engineering or intelligent systems. Students who do not meet the above mentioned requirements for a specialization would graduate with a general M. Tech. in Computer Science and Engineering degree.

To summarize:

S. No.	Category	Credits
1.	Core courses	11
2.	Discipline electives (DE)	20
3.	Outside discipline electives (ODE)	9
4.	Exploratory work (EW)	3
5.	Postgraduate project (PGP)	26
6.	Technical Communication	1

Total credits per semester: 16-20

### Year 1, Semester 1

S.No.	Subject	Credits	Remarks
1	Discrete Mathematics <b>OR</b> Linear Algebra AND Probability and Statistics	4	Core: The first option is recommended for a specialization in Systems Engineering and the second for a specialization in Intelligent Systems. Also, in the second option, two 2-credit courses will be offered in the first and the second halves of the semester.
2	Advanced CS Practicum	3	Core
3	Advanced Data Structures and Algorithms	4	Core
4	Electives	5 - 7	DE / ODE

**Total Credits: 16 - 18**

**Year 1, Semester 2**

S.no.	Subject	Credits	Remarks
1	Electives	16 - 20	DE/ODE

**Total Credits: 16 - 20**

**Year 2, Semester 3**

S.no.	Subject	Credits	Remarks
1	PGP	12	
2	Electives	4-8	DE/ODE

**Total credits: 16 - 20**

**Year 2, Semester 4**

S.no.	Subject	Credits	Remarks
1	PGP	14	2 credits are reserved for the thesis report.
2	Electives	Remaining credits	DE/ODE

**Total credits: 16 - 20**

## 5. Overview of Core Courses

### **Core 1a: Discrete Mathematics (DM; 4 credits)**

Logic. Infinite and structured sets. Combinatorics and counting. Graph theory: matching, coloring. Modern techniques: extremal, probabilistic, and linear algebraic methods.

### **Core 1b: Linear Algebra and Applications (LAA; 2 credits)**

Background and review. Norms for vectors and matrices. Perturbation theory and eigenvalue problems. Matrix factorization and least square problems. Sparse matrices, their analysis, and algorithms. Different types of matrices, their properties, and applications.

### **Core 1c: Probability and Statistics (PS; 2 credits)**

Sigma field. Random variables. Conditional distribution and expectations. Markov chains. Convergence of random variables. Concentration inequalities. Random vectors and random processes.

### **Core 2: Advanced Data Structures and Algorithms (ADSA; 4 credits)**

Basic math concepts. Sorting and Selection. Priority queues. Graph Definitions and Elementary Algorithms. Graph Matching. Flow-Networks: Matrix Computations. All Pair Shortest Path and dynamic programming. Integer data type. String Matching. Linear Programming. Randomized and Streaming Algorithms. External Memory Algorithms and Cache oblivious algorithms. NP-completeness. Dealing with NP-hard problems. Approximation algorithms. Parameterized complexity.

### **Core 3: Advanced Computer Science Practicum (ACSP; 3 credits)**

End-to-end system design that involves database backend with transactions, triggers, etc., and front-end web-based visualization; design of modules/device drivers in operating systems; network simulator; assignments on compilers, and architecture.

## 6. Suggestive List of Discipline Electives in Specialization Areas

The courses currently available for crediting as discipline electives in the areas of specialization are listed below. The PFG may add more courses in the future.

### Systems Engineering:

CS502	Compiler Design	3-0-2-4
CS507	Computer Architecture	3-0-2-4
CS508	Introduction to Heterogeneous Computing	2-0-0-2
CS547	Network Management Systems	3-0-0-3
CS548	Cloud Networking	3-0-0-3
CS545	Software Design Patterns	3-0-0-3
CS546	Design of Concurrent Software	3-0-0-3
CS549	Computer Network Analysis	3-0-0-3
CS550	Introduction to Computer Graphics and Geometric Design	3-0-2-4
CS561	Map Reduce and Big Data	3-0-0-3
CS611	Program Analysis	3-1-0-4

### Intelligent Systems:

CS560	Text Retrieval and Mining	3-0-0-3
CS562	Artificial Intelligence	3-0-0-3
CS563	Scalable Data Science	3-1-0-4
CS609	Speech Processing	3-0-2-4
CS630	Speech Technology	3-0-0-3
CS660	Data Mining for Decision Making	4-0-0-4
CS661	Knowledge Representation and Reasoning	3-0-0-3
CS669	Pattern Recognition	3-1-0-4
CS671	Deep Learning and Applications	3-1-0-4
EE511	Computer Vision	3-0-2-4
EE608	Digital Image Processing	3-0-2-4

### Outside Discipline Electives:

Any graduate level course outside of the Computer Science and Engineering discipline from the school or from other schools are acceptable as Outside Discipline Electives.

## 7. Placements

Here is a non-exhaustive list of companies/government organisations that might be interested to hire the students graduating with an M.Tech. in CSE from IIT Mandi:

● Amazon	● Infosys
● Flipkart	● Vehant
● DRDO	● TCS
● Siemens	● Samsung
● Facebook	● IBM
● Google	● Intel
● Microsoft	● Nvidia
● AMD	

## 8. Program Outcomes

After completion of the degree, the students is expected to attain:

- Good understanding of the design challenges and implementation of scalable solutions.
- Those opting for specialization will have sufficient knowledge and practical experience with the problems being faced, and the solutions being proposed therein, in their respective areas of specialization: systems engineering, or intelligent systems.
- Adequate communication skills and experience of working as a team.
- Be equipped with the necessary knowledge and skills to get placed in CS-related industries or enter into Ph.D. programs in computer science or research labs.