

Regulations for **B.Tech. in Computer Science and Applied Mathematics**

The increasing use of sophisticated mathematical tools and techniques in tandem with computational tools in several areas such as computational finance, biology, e-commerce, weather forecasting, and data science motivates the need for a program that will produce graduates with computational skills as well as the ability to use sophisticated mathematical concepts and tools in order to tackle these problems.

The Computer Science and Applied Mathematics program aims to develop such graduates. The program is similar to the Mathematics and Computing programs operating in many leading Institutions. The program has a small set of core courses in both Computer Science and Mathematics, and many electives which can be taken from both the disciplines. This enables the students to build a program most suitable for them. It is possible for a student of this program to complete the requirements necessary to appear for the JRF/NET exam in Mathematical Sciences (including Statistics) jointly conducted by UGC and CSIR, or the GATE exam in Mathematics/Computer Science.

This document specifies the specific regulations for the BTech (CS & AM) program – the general regulations for the BTech program are given in a separate document.

Program Objectives: At the end of this program, a student should have:

1. Understanding of foundational topics in Mathematics.
2. Understanding of theoretical foundations and limits of computing and different levels of abstraction including architecture and operating systems, algorithms, and applications.
3. Ability to design and implement algorithms and data structures for efficiently solving new problems.
4. Ability to use and apply mathematical and statistical techniques and tools to solve problems.
5. Ability to abstract and rigorously model and analyze a variety of problems using appropriate mathematical or computational concepts.

In addition, the graduate of this program should also have the following general skills that are common with other BTech programs:

6. Ability to function effectively in teams to accomplish a common goal.
7. An understanding of professional and ethical responsibility.
8. Ability to communicate effectively with a wide range of audience.
9. Ability to self learn and engage in life-long learning.
10. Ability to undertake small research tasks and projects.
11. Ability to take an idea and develop into a business plan for an entrepreneurial venture (if desired).
12. An understanding of the impact of solutions in an economic, societal, and environment context.

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1. Program Structure

The BTech program at IIT-D follows the philosophy of having a small set of core courses and many electives allowing students significant flexibility in designing their curriculum and specialization. The overall program structure is given in the table below. The first year program is common with other BTech programs - this allows change of discipline after 1st Year. 2nd Year is mostly core courses. In the 3rd year, there are some core courses and rest are electives. In the final year, all courses are electives (except special electives, other electives are not mentioned in the table.) In the program below, the placement of courses in semester is only indicative and not a part of the requirements.

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6
Introduction to Programing	Data Structures and Algorithms	Maths III- Multivariable Calculus, Vector Calculus, Complex Variables	Maths IV- ODE/ PDE	<i>Special Elective-3</i>	Optimization/ Linear Optimization
Digital Circuits	Basic Electronics	Computer Architecture and Operating Systems	Abstract Algebra I	Probability and Random Processes	Statistical Inference
Maths I-Linear Algebra	Maths II- Probability and Statistics	Discrete Mathematics	Algorithm Design and Analysis		
Systems Management	Introduction to Engineering Design	<i>Special Elective -1</i>	<i>Theory of Computation</i>		
Communication Skills	HSS/Eco	[HSS]	<i>Special Elective-2</i>	TCOM(2Cr) + Environment(2Cr)	

Structure of Special Electives:

The course structure allows a student sufficient flexibility in the choice of elective courses and thus structure the program to their interest. However, in choosing electives, the following rules must be followed.

- **Special Elective 1:** In this a student can select from a set of defined courses depending on his/her preference. It can be one of the following (this set may be changed later)
 - Elementary Number Theory
 - Advanced Programming
 - Introduction to Physics
 - Signals and Systems

- **Special Elective 2:** This elective is from the set of courses such as Science, Bio (To be decided)
- **Special Elective 3:** This elective in **Semester V** is a choice between
 - Real Analysis
 - Numerical Methods.

It is strongly advised that a student do both courses. One in this slot and the other as a regular elective.

List of courses and further information about the courses is available on the website: <http://www.iiitd.ac.in/education/courses>

2. Requirements for Graduation

For a BTech (CS & AM) degree, a student must satisfy all the following requirements:

1. Earn a total of 152 credits (equivalent to 38 full courses – 20 courses in the first two years and 18 courses in the last two years).
2. In addition, do 2 credits of Community Work and Self Growth each. These are pass/fail credits, which are required to be completed, but do not count for fulfilling the credit requirement.
3. Successfully complete all the core courses and special electives.
4. Do at least 12 credits of Humanities and Social Sciences Courses.
5. A student may take “Independent Project” or “Independent Study” or “Undergraduate Research” courses for 1, 2, or 4 credits. No more than 8 of these credits can count towards satisfying the credit requirements of the degree. Only students with satisfactory CGPA (at least 7.5) or with a strong interest in some area (the faculty advisor to determine this) can take these courses.
6. In the last four semesters, do at least 32 credits of CSE/Maths courses, which should include at least 12 credits of CSE and 12 credits of Maths courses. BTP/Independent project/Independent study/Undergraduate Research cannot count for this requirement. UGC may approve some other relevant courses (e.g., ECE, Computational Biology, etc.) to be counted as CSE/Maths courses for this purpose.
7. A BTech Project (BTP) is optional. A student opting for BTP, may take a total of 8 to 12 credits of BTP. Credits of a BTP which is not completed will be treated as IP/IS/UR credits.

3. Honors Program

The BTech (CS & AM) program has the Honors option, requirements for which are same as specified in the regulations for the BTech program. Namely;

1. The student must earn an additional 12 credits (i.e. must complete at least 164 credits).
2. The student’s program must include a BTech Project.
3. At graduation time, the student must have a CGPA of 8.0 or more.

In order to allow students to make informed choices about elective courses, a set of streams is envisaged - which is a sequence of at least three courses. Streams are merely suggestive, and there is no compulsion on the part of the student to follow a sequence. The streams and courses listed below are some possibilities. They may change based on the availability of faculty and student interest.

Stream	Courses
Pure Mathematics	Analysis II, Functional Analysis, Abstract Algebra II, Graph Theory
Algebra and Computation	Abstract Algebra II, Coding Theory, Algebra and Computation, Information Theory
Algorithms and Complexity	Modern Algorithm Design, Randomized Algorithms, Approximation algorithms, Complexity Theory, Quantum Computing, Information Theory, Fourier analysis and applications.
Optimization	Linear Optimization, Convex Optimization, Combinatorial Optimization, Game Theory, Algorithmic Game Theory, Supply Chains, Reliability and Performance Analysis
Statistics and Data Science	Statistical Computations, Machine Learning, Pattern Recognition, Random Networks, Big Data Analytics, Statistical Computing, Data Mining, Estimation Theory, Regression, Sampling, Information Theory
Biology	Molecular Biology and Biochemistry, Algorithms in Computational Biology, Systems Biology
Economics	Introduction to Economic Analysis, Applied Econometric Analysis, Game Theory
Applied Mathematics	Mechanics, Physics, Fluid Mechanics and Computational Fluid Dynamics