INDRAPRASTHA INSTITUTE of INFORMATION TECHNOLOGY DELHI

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Regulations for B.Tech. Computer Science and Applied Mathematics (CSAM) Program

1. Preamble

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 B.Tech. (CSAM) program – the general regulations for the B.Tech. 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 B.Tech. 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.

This document specifies the specific regulations for B.Tech. (CSAM) program-the general regulations for the B.Tech. Program are given in a separate document.

2. Program Structure

1. The B.Tech. program at IIIT-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 semester courses are common with other B.Tech. programs,-this allows change of discipline after 1st Semester. Semester 2-4 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.

   For students of 2019 batch onwards

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6
Introduction to Programing	Data Structures and Algorithms	Real Analysis I	Math IV (ODE/ PDE)	*Special Elective-3*	Optimization/ Linear Optimization
Digital Circuits	Basic Electronics	Operating Systems	Abstract Algebra I	Stochastic Processes and Applications	Statistical Inference
Maths I (Linear Algebra)	Maths II (Probability and Statistics)	Discrete Structures	Algorithm Design and Analysis		
Prototyping Interactive Systems	Computer Organization	*Special Elective -1*	*Theory of Computation*		
Communication Skills	[SSH]	[SSH]	*Special Elective-2*	Technical Communication + Environmental Science	

For students of 2018 and previous batches

SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6
Introduction to Programing	Data Structures and Algorithms	Real Analysis I	Math IV (ODE/ PDE)	*Special Elective-3*	Optimization/ Linear Optimization
Digital Circuits	Basic Electronics	Computer Architecture and Operating Systems	Abstract Algebra I	Stochastic Processes and Applications	Statistical Inference
Maths I (Linear Algebra)	Maths II (Probability and Statistics)	Discrete Structures	Algorithm Design and Analysis		
Systems Management	Introduction to Engineering Design	*Special Elective -1*	*Theory of Computation*		
Communication Skills	[SSH]	[SSH]	*Special Elective-2*	Technical Communication + Environmental Science	

2. List of technical and non-technical courses of first year

Semester	**Technical Courses**	**Non-Technical Courses**
Semester 1	Introduction to Programming Digital Circuits Math I Prototyping Interactive Systems	Communication Skills
Semester 2	Data Structures and Algorithms Basic Electronics Probability and Statistics Computer Organization	SSH Elective

Structure of Special Electives:

The course structure allows a student sufficient flexibility in the choice of elective courses and thus structures 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)
  - Number Theory
  - Advanced Programming
  - 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 II
    - Scientific Computing

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: https://www.iiitd.ac.in/academics/courses

3. Requirements for Graduation

For a B.Tech.(CSAM) degree, a student must satisfy all the following requirements:

1. Earn a total of 156 (inclusive of 2 credits each of SG/CW credits) credits (equivalent to 39 full courses – 21 courses in the first two years and 18 courses in the last two years).
2. Successfully complete all the core courses and special electives.
3. Complete at least 12 credits of Social Science and Humanities (SSH) Courses.
4. Do 2 credits of Community Work and Self Growth each. These are pass/fail credits, which are required to be completed, and will count for fulfilling the credit requirements.
5. A student may take Online Courses. No more than 8 of these credits can count towards satisfying the credit requirements of the degree.
6. In the last four semesters, a student must complete 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 will not count towards this requirement. UGC may approve other relevant courses (e.g., ECE, Computational Biology, etc.) to be counted as CSE/Maths courses for this purpose. Online courses of the respective discipline (i.e. online courses with CSE or MTH course code), if done in last four semesters will count towards this requirement.
7. A B.Tech. Project (BTP) is optional. A student opting for BTP, may take a total of 8 to 12 credits of BTP spread over minimum 2 semesters. A student not completing BTP credits will have to forgo the partial BTP credits earned earlier done and those will not be counted towards the credit requirement of 156 credits.
8. A student may take “Independent Project” or “Independent Study” or “Undergraduate Research” courses for 1, 2, or 4 credits in a semester. 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) and CGPA of atleast 7.0 can take these courses.

9. A student can take maximum 2, 2xx level courses in 3rd and 4th year.

4. Honors Program

The B.Tech. (CSAM) program has the Honors option, requirements for which are same as specified in the regulations for the B.Tech. program. Namely;

1. The student must earn an additional 12 discipline credits (i.e. must complete at least 168 credits).
2. The student's program must include a B.Tech. Project.
3. At graduation time, the student must have a CGPA of 8.0 or more.

Change History

- **July 2016 release** – Version 1
- **April 2017** release – Minor changes
- **July 2017 release** – Minor changes

- **July 2019 release**

(i) Counting of SG, CW credits in total credits. Applicable from 2017 batch onwards.
(ii) Total credits requirement for graduation and credit requirement for Honors students. Applicable from 2017 batch onwards.
(iii) Courses for Honors students. Applicable from 2017 batch onwards.
(iv) Discontinuation of BTP to IP conversion. Applicable from AY2019-20.
(v) Technical Courses
(vi) 2xx level courses

- **August 2019 release**

(i) Program Structure Pnt 2.1.
(ii) List of technical and non-technical courses in the first year, pnt 2(B). For students of 2018-2016 batches

Semester	**Technical Courses**	**Non-Technical Courses**
Semester 1	Introduction to Programming Digital Circuits Math I System Management	Communication Skills

Semester 2	Data Structures and Algorithms Basic Electronics Probability and Statistics Introduction to Engineering Design	SSH Elective

Appendix: Streams

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	Micro Economics, Applied Econometric Analysis, Game Theory
Applied Mathematics	Mechanics, Physics, Fluid Mechanics and Computational Fluid Dynamics

*Note: Streams in the UG programs has now been discontinued. It will not be shown on the transcript. However, the students may be guided about the courses belonging to a certain area during the course counseling session conducted at the beginning of the semester. Guidance on streams should also be put on the website for information of the students.