B. Tech. (Computer Science and Engineering) Curriculum

International Institute of Information Technology
Bangalore – 560100

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1 Introduction

This document describes the curriculum for the proposed undergraduate B. Tech. (Bachelor of Technology) program in CSE (Computer Science and Engineering). The document details the overall program structure, total credits with a semester-wise break-up of the credits and a break-up of the credits with reference to the various groups of core and elective courses.

Overall B. Tech. Programme Structure (minimum 158 credits)

Semester 1 (15 weeks)	**18 credits** • 6 core courses
Semester 2 (15 weeks)	**18 credits** • 5 core courses (1 of the core courses is only a half-semester 2-credit course)
Semester 3 (15 weeks)	**22 credits** • 7 core courses (3 of the core courses are only a half-semester 2-credit course)
Semester 4 (15 weeks)	**20 credits** • 4 core courses • 1 elective
Semester 5 (15 weeks)	**20 credits** • 2 core courses • 3 electives
Semester 6 (15 weeks)	**24 credits** • 6 electives
Semester 7 (15 weeks)	**24 credits** • 6 electives
Semester 8 (15 weeks)	**12 credits** • Project/Internship/Thesis

The course credits earned over 8 semesters are grouped into the following categories:

- Mathematics and Basic Sciences (MBS)

- Humanities and Social Sciences (HSS)
- CSE Core (CC)
- Systems (Sys)
- Programming (Prog)
- Branch Electives for CSE -- (BE)
- General Electives
- Bachelor's Thesis/Project/Internship

The break-up of credits under each category is in the table below. The courses under each category are in the tables that follow.

Computer Science and Engineering (CSE)	
Heads	**Credits**
Programming	14
Systems	20
CSE Core (CSE)	20
Humanities and Social Sciences (1 elective)	16
Mathematics and Basic Sciences	16
Branch Electives (6 CSE electives)	24
Other electives (9 open electives)	36
Internship/Thesis/Project	12
Total	158

1.1 Programming

The list of courses under the programming category is given in the following table.

Course Name	Credits	L:T:P:C
Programming IA (C)	2	1:0:2:2
Programming IB (Python)	2	1:0:2:2
Data structures and Algorithms	6	3:1:4:6
OOP IA (C++)	2	1:0:2:2
OOP IB (Java)	2	1:0:2:2

Table 1: Programming

1.2 Systems

The following table contains the courses under the systems category.

Course Name	Credits	L:T:P:C
Digital Design	4	3:1:0:4
Signals and Systems	4	3:1:0:4
Computer Networks	4	3:1:0:4
Computer Architecture – Processor Design **(half-semester course)**	2	3:1:0:2
Computer Architecture – Memory Design **(half-semester course)**	2	3:1:0:2
Operating Systems	4	3:0:2:4

Table 2: Systems

1.3 CSE Core

The following table contains the courses under the category of core courses exclusive to CSE.

CSE Core Course Name	Credits	L:T:P:C
Discrete Mathematics	4	3:1:0:4
Design and Analysis of Algorithms	4	3:1:0:4
Automata Theory and Computability	4	3:1:0:4
Software Engineering	4	3:0:2:4
Database Systems	4	3:0:2:4

Table 3: CSE Core

1.4 Humanities and Social Sciences

The courses under this category are listed in the following table

Course Name	Credits	L:T:P:C
Technical Communication	2	2:0:0:2
English	2	2:0:0:2
Economics	4	3:1:0:4
Social Pathways to Information Technology	4	3:1:0:4
An elective in Humanities and Social Sciences	4	3:1:0:4

Table 4: HSS

1.5 Mathematics and Basic Sciences

The following table lists the courses under this category.

Course Name	Credits	L:T:P:C
Mathematics - 1	4	3:1:0:4

Course Name	Credits	L:T:P:C
Mathematics - 2	4	3:1:0:4
Mathematics - 3	4	3:1:0:4
Physics	4	3:0:2:4

Table 1: Mathematics and Basic Sciences

1.6 Electives and Branch Electives

Apart from the courses specified in the previous sections, CSE students need to take **at least** 15 elective courses, each carrying 4 credits. **Note that this excludes the 1 elective from the Humanities and Social Science pool.** The students can plan their electives starting from the 4th semester to the 7th semester. The elective courses can be spanned across various departments.

While students are given the flexibility to choose their electives from various departments, out of the 15 electives, 6 electives will be considered as CSE branch electives (BE). Moreover, these branch electives compulsorily need to be from the Theoretical Computer Science (TCS) and Software Systems (SSY) pool, with 3 electives from each of these specializations.

A list of candidate branch electives under the TCS and SSY pool is given in the following table. Note that this list is not permanent and may be changed every year, depending upon the availability of the courses.

TCS Branch Electives for CSE Branch	**SSY Branch Electives for CSE Branch**
Approximation Algorithms	Software Systems & System software
Foundations of Cryptography	Cryptographic Engineering
Advanced Algorithms	Computer Graphics
Topological Data analysis	Software production engineering
Computational Geometry	Design Patterns and Enterprise system development
Graph Theory	Software Testing
Foundations of Distributed Consensus and Blockchains	Data Modelling
Topics in Artificial Intelligence	Data Visualization
Concrete Mathematics	NoSQL

Compilers	Software Design Practices
Topics in Computability and Learning	
Programming Languages	
Secure Computation	
Algorithmic Thinking	

1.7 Project and Reading Electives

A project elective (PE) is a special type of 4-credit elective, where a student registers for a semester-long project under the supervision of a faculty member and is graded based on the project delivered. Similarly, a reading elective (RE) is a special type of 4-credit elective, where a student registers under a faculty member for some advanced-level research topic. Typically the student will be provided some research material to read and present (for example, a set of research papers or some chapters from a research monogram) and the student is graded based on how well the student has understood and presented the material.

Note that PEs and Res are **optional**. A **maximum** of 1 PE and 1 RE can be taken by a student throughout their entire programme. Note that PE and RE **do not** count towards branch electives.

2 Bachelor's Project / Thesis/ Internship

A student can do either a 12-credit B.Tech project or a 12-credit thesis under the supervision of a faculty member at IIITB during their 8th semester. Alternatively, students also have an option to do a 12-credit internship during their 8th semester.

3 Other General Courses

Apart from the above courses, the students also need to compulsorily pass other general courses as specified in the following table

Course Name	Credits	L:T:P:C
Physical Education 1	0	0:4:0:0
Physical Education 2	0	0:4:0:0

4 Optional Specialization, Major and Minor

CSE students are encouraged to specialize in one of the following listed domains.

- TCS (Theoretical Computer Science).
- SSY (Software Systems).
- NC (Networking and Communication).

To get a specialization, a student must earn an additional 20 credits in that specific domain by doing **additional** elective courses offered in that domain. Note that a **maximum** of 1 PE and 1 RE can be counted for getting a specialization. Moreover, these additional electives must be **different** from the branch electives. Students completing a CSE specialization (non-minor) with a CGPA above or equal to 3.5 out of 4.0 will be graduating with a B.Tech. (CSE) Honours with specialization in the respective domain.

Alternatively, a CSE student can earn a minor in a non-CSE area by completing an **additional** 20 credits in the area chosen. The minor could be in one of the following listed areas.

- VLSI (VLSI Systems).
- DT (Digital Society).

Note that a **maximum** of 1 PE and 1 RE can be counted for getting a minor.

The above lists of areas for specialization and minor are subject to change and refinements from time to time. Also, note that students can complete B.Tech. (CSE) programme **without** the requirement of earning a specialization or minor with extra credits.

5 Course Sequencing for BTech (CSE)

The course sequencing for the CSE branch is given in the following table.

Course Name	Credits	Course Category	Level
SEMESTER 1	**18**		
Mathematics - 1	4	Mathematics and Basic Sciences	Level 1
Programming IA (C)	2	Programming	Level 1
Programming IB (Python)	2	Programming	Level 1
Digital Design	4	Systems	Level 1
Physical Education 1	0	Others	Level 1
English (HSS-1)	2	Humanities and Social Sciences	Level 1
Economics (HSS-2)	4	Humanities and Social Sciences	Level 1
SEMESTER 2	**18**		

Course Name	Credits	Course Category	Level
Mathematics - 2	4	Mathematics and Basic Sciences	Level 1
Computer Architecture – Processor Design	2	Systems	Level 1
Data Structures and Algorithms	4	Programming	Level 1
Data Structures and Algorithms Lab	2	Programming	Level 1
Computer Networks	4	Systems	Level 1
Technical Communication	2	Humanities and Social Sciences	Level 1
Physical Education 2	0	Others	Level 1
SEMESTER 3	**22**		
Mathematics - 3	4	Mathematics and Basic Sciences	Level 1
OOP IA (C++)	2	Programming	Level 1
OOP IB (Java)	2	Programming	Level 1
Physics (Theory)	3	Mathematics and Basic Sciences	Level 1
Physics (Lab)	1	Mathematics and Basic Sciences	Level 1
Signals and Systems	4	Systems	Level 1
Discrete Mathematics	4	CSE Core	Level 1
Computer Architecture – Memory Design	2	Systems	Level 1
SEMESTER 4	**20**		
Operating Systems (Theory)	3	Systems	Level 1
Operating Systems (Lab)	1	Systems	Level 1
Design and Analysis of Algorithms	4	CSE Core	Level 1
Database systems (Theory)	3	CSE Core	Level 1
Database systems (Lab)	1	CSE Core	Level 1
HSS-3	4	Humanities and Social Sciences	Level 1
Elective-1	4	Elective	Level 1
SEMESTER 5	**20**		
Automata theory and Computability	4	CSE Core	Level 1
Software Engineering (Theory)	3	CSE Core	Level 1
Software Engineering (Lab)	1	CSE Core	Level 1
Elective-2	4	Elective	Level 1
Elective-3	4	Elective	Level 1
Elective-4	4	Elective	Level 1
SEMESTER 6	**24**		
Elective-5	4	Elective	Level 2
Elective-6	4	Elective	Level 2
Elective-7	4	Elective	Level 2
Elective-8	4	Elective	Level 2
Elective-9	4	Elective	Level 2
Elective-10	4	Elective	Level 2
SEMESTER 7	**24**		
Elective-11	4	Elective	Level 2 / Level 3
Elective – 12	4	Elective	Level 2 / Level 3

Course Name	Credits	Course Category	Level
Elective – 13	4	Elective	Level 2 / Level 3
Elective – 14	4	Elective	Level 2 / Level 3
Elective – 15	4	Elective	Level 2 / Level 3
Elective – 16	4	Elective	Level 2 / Level 3
SEMESTER 8	**12**		
B.Tech. Project / Thesis / Internship	12	Project/Thesis/Internship	Bachelor's Project/Thesis/Internship

Table 10: Course Sequencing for B.Tech (CSE)

(**1 Humanities and Social Science Elective course needs to be completed by the student in any semester starting from the 4th semester to the 7th semester as a graduation requirement**)