International Institute of Information Technology Bangalore

Curriculum Document

B.Tech. in Computer Science and Engineering

B.Tech. (Hons) in Computer Science and Engineering

Batch 2025 – 2029

Version 1.0

August 2024

Document Version Record

Version Number	Version Date	Status
1.0	May 31, 2024	Approved by the Senate in the 97th meeting of the Senate

Table of Contents

I. About IIIT-Bangalore

International Institute of Information Technology Bangalore (IIIT-B) is a Deemed to be University founded in 1998. The Vision of IIIT-B is to **build on the record of accomplishment set by India in general and Bengaluru in particular, to enable India to play a key role in the global IT scenario through a world-class institute with a focus on education and research, entrepreneurship, and innovation.**

IIIT-B's mission is to contribute significantly to Information Technology for transforming the lives of individuals and society, and efficient conduct of sustainable businesses, social enterprises, and Governments. The three pillars that help IIIT-B be at the forefront of Computing Education in the country are:

- **Education**: Undergraduate, Postgraduate, PhD, PG Diploma, Certification Programmes.
- **Research**: Spans across all areas of computing cutting across 7 research domains.
- **Innovation and Entrepreneurship**: Promoting entrepreneurship and start-ups through various initiatives.

II. Curriculum Design and Principles

The field of computing has evolved in the last few years, with both science and technology advancing at an unprecedented pace. The technologies and underlying computing systems have also evolved, improving the ease of implementation of some tasks that earlier took

much more training and experience. These changes require engineering pedagogy to suitably adapt—to reflect the changed nature of the discipline, as well as to update courses with more recent technology platforms.

IIIT Bangalore has adopted the following key guiding principles in the design of this curriculum:

- The focus of curriculum design is the 4-year BE/B.Tech program, benchmarked against the best institutions of the country.
- Exercise the flexibility offered by AICTE curriculum guidelines to enable students to fully benefit from the high-quality faculty and world-class lab and research infrastructure available at IIIT-B.
- Motivate fast learners and high performers by giving them the option to obtain deep expertise, leading to the award of Honours with a specialization, OR explore auxiliary areas leading to the award of a Minor in another department.
- Introduce discipline courses in CSE early, in order to provide exposure to skill-oriented courses like programming early in the scheme of study. This early exposure to discipline courses provides students with more time to absorb and develop a solid foundation.

III. Graduate Attributes

The curriculum of a program is, ultimately, a network of credit units—courses (core, disciplinary core, disciplinary elective, open), internships, practice, projects, etc.—which help achieve the program goals. Program goals can be stated as attributes the students should possess upon graduation, i.e., statements about the learning, values, capabilities, etc., of graduates. These are called Graduate Attributes (GAs). A program typically has:

- **General GAs**: These are often common across many similar programs (e.g., B.Tech programs) and focus on generalized skills and capabilities in the graduate.

- **Discipline GAs**: These are discipline-specific attributes, which focus on understanding different concepts and systems related to the discipline, as well as on competencies and skills in that discipline.

Together, the GAs defines the goals of the program. The aim of IIIT-B's curriculum design is to evolve a curriculum that can develop in students the stated graduate attributes. While specifying the GAs and designing a curriculum to support them, a basic constraint is kept in mind: a full B.Tech program has 8 semesters, each with about 5 full courses. GAs should specify only what can be taught and absorbed within this time box.

The desired Graduate Attributes for the B.Tech program, adopted from the AICTE model curriculum document, are given below. The curriculum design focuses more on delivering the Discipline GAs, while strengthening the General GAs where possible. Each GA should be read by adding this phrase at the beginning: **"At graduation time, a student should have..."**

General Graduate Attributes
G1 Ability to identify a problem, analyze using design thinking techniques, and evolve innovative approaches for solving it.
G2 Ability to apply mathematical concepts and techniques in problem solving.
G3 Ability to function effectively in multi-cultural teams to accomplish a common goal.
G4 Ability to communicate effectively with a wide range of audience.
G5 Ability to self-learn and engage in life-long learning and upgrade technical skills.
G6 An understanding of professional and ethical responsibility.
G7 Ability to undertake small research tasks and projects.
G8 An entrepreneurial mind set for opportunities using technology and innovations.

G9 An understanding of the impact of solutions on economic, societal, and environmental context.
G10 Strong emotional intelligence, human and cultural values.

IV. General Norms for B.Tech Programmes

This section elaborates on the common norms applicable across all B.Tech. programmes offered by IIIT-B.

4.1: Programme Outcomes

The following are the Programme Outcomes (POs) of the IIIT-B B.Tech. programmes:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, research literature, and analyze complex engineering problems, reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet specified needs, with appropriate consideration for public health and safety, and the cultural, societal, and environmental contexts.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods, including the design of experiments, analysis and interpretation of data, and synthesis of information, to provide valid conclusions.
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues, and the consequent responsibilities relevant to professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate knowledge of, and the need for, sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities, and the norms of engineering practice.
9. **Individual and Teamwork**: Function effectively as an individual, and as a member or leader in diverse teams and multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large—such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work—as a member and leader in a team—to manage projects and operate in multidisciplinary environments.
12. **Life-Long Learning**: Recognize the need for, and possess the preparation and ability to engage in, independent and life-long learning (LLL) in the broadest context of technological change.
13. **Research and Development**: Independently carry out research, investigation, and development work to solve practical problems.

4.2: Credit System

All courses in the curriculum have credits allocated to them. The credit definition follows the **L:T:P:C** system, where:

- **L (Lecture)**: Number of credit hours under the Lecture category.
- **T (Tutorial)**: Number of credit hours under the Tutorial category.

- **P (Practical)**: Number of credit hours under the Practical category.
- **C (Credits)**: Total credits associated as a combination of Lecture, Tutorial, and Practical hours.

Note:

- One credit hour under "L" and "T" translates into one hour of instruction.
- One credit hour under "P" translates into two hours of instruction.

4.3: Grading System

IIIT-B follows a 4-point credit system for all programmes. Every student's academic performance is measured using the **Cumulative Grade Point Average (CGPA)**, which can take values between **0.00 and 4.00 (inclusive)**.

The CGPA is calculated as a weighted average of the student's grades and the credits associated with the courses completed by the student.

Letter Grade	Grade Points
A	4.00
A-	3.70
B+	3.40
B	3.00
B-	2.70
C+	2.40
C	2.00

D	1.00
F	0.00
S	Grade points Not applicable
X	Grade points Not applicable

4.4: Course Categories

All programmes at IIIT Bangalore follow the **Choice-Based Credit System (CBCS)** as recommended by AICTE. CBCS allows students to exercise their choice in selecting elective courses as per their interests. The different categories of courses included in the IIIT-B curriculum are given below:

S. No.	Course Category	Description
1.	Engineering Core	General Core courses are those that are considered to be foundational to all B.Tech. programmes and are compulsory for all students enrolled in B.Tech. programmes.
2.	Branch Core	Branch Core courses are considered to be foundational in nature to a particular branch of study (e.g., CSE or ECE). Branch Core courses are compulsory for all students who are pursuing B.Tech. in that particular branch.
3.	Branch Elective	Branch Electives constitute the set of elective courses that are specific to their Branch (e.g., specific to CSE for the CSE branch or specific to ECE for the ECE branch). Students are

		expected to enroll in a specified number of Branch Electives as part of the curriculum.
4.	Open Elective	Open Electives are those courses that are open to students belonging to all the Departments, provided the necessary course pre-requisites are satisfied.
5.	Project Elective (PE)	*Project Elective (PE) is a special type of elective intended to provide experiential learning for the student by giving them an opportunity to work on a project under the guidance of a faculty member.*
6.	Reading Elective (RE)	*Reading Elective (RE) is a special type of elective intended to provide research orientation for the student by giving them an opportunity for systematic study of a research area under the guidance of a faculty member.*
7.	Internship	Internship refers to credits earned through extended project work taken up in the industry or other academic institutions, either within India or outside India. A specified number of internship credits are mandatory for all students.

4.5: Multi-Disciplinary Courses

In line with the recommendations of **NEP 2020**, the IIIT-B B.Tech. Curriculum includes provisions for students to pursue courses from multiple disciplines. The disciplines covered are:

S. No.	Discipline	Details
1.	Engineering	Computer Science, Electronics, Data Science, Robotics, AI.
2.	Humanities and Social Science (HSS)	English, Economics, Digital Society, Ethics.
3.	Creative Arts	Workshops by Theatre Club, Music Club, Art Club.
4.	Indian Knowledge Systems (IKS)	Yoga and related areas.
5.	Healthcare	Assistive technologies for the visually impaired, mobility impaired, and mental health.

V. Other Common Courses

Apart from the above courses from the Engineering curriculum, students also need to compulsorily pass other non-credit general courses as specified below.

5.1: Physical Education

Course Name	Credits

Physical Education 1	0
Physical Education 2	0

5.2: Value Added Learning Program (VALP)

Students are expected to enroll in courses listed under the **Value-Added Learning Programme (VALP)**, announced from time to time. The following non-credit courses, as mandated by AICTE, will be conducted under **VALP**:

Course Name	Credits
Induction Program	0
Environmental Sciences	0
Indian Constitution	0
Essence of Indian Knowledge Systems	0

Additional courses in Music, Art, Dance, Life Skills, etc., may also be offered.

VI. Degree Variants

The curriculum of IIIT Bangalore supports three variants that students can opt for depending on their interests and capabilities.

6.1: Variant #1 - B.Tech. in one of the branches

Every student admitted to the B.Tech. programme is automatically eligible to pursue and obtain a Degree in Bachelor of Technology in their respective branch. The curriculum requirements for this variant are self-contained and meet all norms for the award of the B.Tech. degree.

6.2: Variant #2 – B.Tech. (Honours)

Students who are fast learners and maintain a high CGPA can graduate with a B.Tech. (Honours). The requirements are:

- Earn **20 additional credits** in one specialization area (e.g., Theoretical Computer Science or Software Systems).
- Maintain a **CGPA of 3.5 or above** at the time of graduation.

6.3: Variant #3 – B.Tech. with Minor

Students can pursue a Minor by completing **20 additional credits** from a non-CSE department. Minor options include:

- VLSI Systems (ECE)
- Networking and Communication (ECE)
- Digital Society (DHSS)
- Artificial Intelligence and Machine Learning (DSAI)

VII. Detailed Curriculum for B.Tech. in CSE

7.1: Discipline Graduate Attributes and Programme Specific Outcomes (PSO)

Discipline Graduate Attributes
CS1 Deep proficiency in developing software applications in at least two programming languages.
CS2 Ability to design and apply appropriate algorithms and data structures for evolving efficient computing-based solutions to new problems.
CS3 Understanding of computing systems at the computer architecture, operating systems, and distributed computing levels, and how they affect the performance of software applications.
CS4 Understanding of theoretical foundations, fundamental principles, and limits of computing.
CS5 Ability to analyze large volumes of data employing a variety of techniques for learning, better prediction, decision making, etc.
CS6 (Advanced) Ability to design, implement, and evaluate computer-based systems or applications to meet the desired needs using modern tools and methodologies.
CS7 (Advanced) Ability to develop full-stack applications using one commonly used tech stack and modern tools.
CS8 (Advanced) Understanding of and ability to use advanced techniques and tools in a few different employment-friendly areas.

CS9 (Advanced) Expertise in contemporary technologies such as Cloud Computing, DevOps, etc.

Programme Specific Outcomes (PSO):

PSO1: Architect, design, develop, test, and deploy reliable and efficient software systems to meet the requirements of enterprise and scientific applications.
PSO2: Collect, curate, store, manage, and analyze large data systems for application domains including business process management, scientific data management, web, and social media.
PSO3: Understand the potential and impact of technology in the context of contemporary economic, social, and political issues.
PSO4: Identify, formally model, define, and solve computing problems by applying the knowledge of mathematical principles, theoretical foundations, and limits of computing.

7.2: Curricular Structure

The B.Tech. programme requires a minimum of **154 credits** distributed across 8 semesters. The semester-wise credit distribution is as follows:

Semester	Credits	Details
1	18	6 core courses
2	18	5 core courses (1 half-semester)
3	22	7 core courses (3 half-semester)

4	20	4 core courses + 1 elective
5	20	2 core courses + 3 electives
6	20	5 electives
7	20	5 electives
8	12	Project/Internship/Thesis

Category-wise Credit Distribution:

Category	Credits
Programming	14
Systems	20
CSE Core	20
Humanities and Social Sciences	16
Mathematics and Basic Sciences	20
Branch Electives (6 CSE electives)	24
Other electives (7 open electives)	28
Internship/Thesis/Project	12
Total	**154**

VIII. Category-wise Course Listing

8.1: Programming

Course Name	Credits	L:T:P:C
Programming 1A (C)	2	1:0:2:2
Programming 1B (Python)	2	1:0:2:2
Data Structures and Algorithms	6	3:1:4:6
Programming 2A (C++)	2	1:0:2:2
Programming 2B (Java)	2	1:0:2:2

8.2: Systems

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	2	3:1:0:2
Computer Architecture – Memory Design	2	3:1:0:2
Operating Systems	4	3:0:2:4

8.3: 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 (Theory and Lab)	4	3:0:2:4
Database Systems (Theory and Lab)	4	3:0:2:4

8.4: Humanities and Social Sciences

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 Sciences Core	4	3:1:0:4
Elective in HSS	4	3:1:0:4

8.5: Mathematics and Basic Sciences

Course Name	Credits	L:T:P:C

Mathematics – 1 (Linear Algebra)	4	3:1:0:4
Mathematics – 2 (Probability and Statistics)	4	3:1:0:4
Mathematics – 3 (Calculus and Differential Equations)	4	3:1:0:4
Mathematics – 4 (Optimization)	4	3:1:0:4
Physics for CSE	4	3:0:2:4

8.6: Electives and Branch Electives

Students must complete **13 electives** (excluding the HSS elective), with **6 being CSE branch electives** (3 from Theoretical Computer Science and 3 from Software Systems).

Sample Branch Electives:

Theoretical Computer Science (TCS)	**Software Systems (SSY)**
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

8.7: Project and Reading Electives

- **Project Elective (PE)**: 4-credit semester-long project under faculty supervision.
- **Reading Elective (RE)**: 4-credit research-oriented study under faculty guidance.
- **Note**: A maximum of 2 PE/RE can be taken, and they do not count toward branch electives.

8.8: Bachelor's Project / Thesis / Internship

Students can choose one of the following in their 8th semester:

- **B.Tech Project**: 12-credit project under faculty supervision.
- **Thesis**: 12-credit research work under faculty guidance.
- **Internship**: 12-credit industry or academic internship.

IX. B.Tech. (Hons.) in CSE

Students can graduate with B.Tech. (Hons.) by:

- Earning **20 additional credits** in one specialization (TCS or SSY).
- Maintaining a **CGPA of 3.5 or above**.

Note: A maximum of 2 PE/RE can be counted toward specialization.

X. B.Tech. (CSE) with Minor

Students can pursue a Minor by completing **20 additional credits** from a non-CSE department. Minor options include:

- VLSI Systems (ECE)

- Networking and Communication (ECE)
- Digital Society (DHSS)
- Artificial Intelligence and Machine Learning (DSAI)

Note: A maximum of 2 PE/RE can be counted toward the Minor.

XI. Course Sequencing for BTech (CSE)

The tentative course sequencing for the CSE branch is as follows:

Course Name	Credits	Course Category
SEMESTER 1	**20**	
Mathematics – 1 (Linear Algebra)	4	Mathematics and Basic Sciences
Programming 1A (C)	2	Programming
Programming 1B (Python)	2	Programming
Digital Design	4	Systems
Physical Education 1	0	Others
English	2	Humanities and Social Sciences
Economics - 1	2	Humanities and Social Sciences
Mathematics – 2 (Probability & Statistics)	4	Mathematics and Basic Sciences
SEMESTER 2	**20**	
Mathematics – 3 (Calculus and Differential Eq)	4	Mathematics and Basic Sciences

Computer Architecture	4	Systems
Data Structures and Algorithms	4	Programming
Data Structures and Algorithms Lab	2	Programming
Computer Networks	4	Systems
Economics - 2	2	Humanities and Social Sciences
Physical Education 2	0	Others
SEMESTER 3	**22**	
Technical Communication	2	Humanities and Social Sciences
Programming 2A (C++)	2	Programming
Programming 2B (Java)	2	Programming
Physics (Theory)	3	Mathematics and Basic Sciences
Physics (Lab)	1	Mathematics and Basic Sciences
Mathematics – 4 (Optimization)	4	Mathematics and Basic Sciences
Signals and Systems	4	Systems
Discrete Mathematics	4	CSE Core
SEMESTER 4	**20**	
Operating Systems (Theory)	3	Systems
Operating Systems (Lab)	1	Systems

Design and Analysis of Algorithms	4	CSE Core
Database systems (Theory)	3	CSE Core
Database systems (Lab)	1	CSE Core
Social Sciences Core	4	Humanities and Social Sciences
Elective-1	4	Elective
SEMESTER 5	**20**	
Automata theory and Computability	4	CSE Core
Software Engineering (Theory)	3	CSE Core
Software Engineering (Lab)	1	CSE Core
Elective-2	4	Elective
Elective-3	4	Elective
Elective-4	4	Elective
SEMESTER 6	**20**	
Elective-5	4	Elective
Elective-6	4	Elective
Elective-7	4	Elective
Elective-8	4	Elective
Elective-9	4	Elective

SEMESTER 7	**20**	
Elective-10	4	Elective
Elective – 11	4	Elective
Elective – 12	4	Elective
Elective – 13	4	Elective
Elective – 14	4	Elective
SEMESTER 8	**12**	
B.Tech. Project / Thesis / Internship	12	Project/Thesis/Internship

Note: One HSS elective must be completed between the 4th and 7th semesters.

End of Document