



International Institute of Information Technology Bangalore

Curriculum Document

iMTech. in Computer Science and Engineering
iMTech. (Hons) in Computer Science and
Engineering Batch

2024 – 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

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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 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/IMTech 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 Honors with a specialization, OR explore auxiliary areas leading to the award of a Minor in another department.
- Introduce discipline courses in CSE early, to provide exposure to skill-oriented courses like programming early in the course 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's 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., IMTech 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 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 students with the stated graduate attributes. While specifying the GAs and designing a curriculum to support them, a basic constraint is kept in mind: a full IMTech program has 8 semesters, each with about 5 full courses. GAs should specify only what can be taught and absorbed within this time frame.

The desired Graduate Attributes for the IMTech 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 audiences.
G5 Ability to self-learn and engage in lifelong 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 contexts.

G10 Strong emotional intelligence, human and cultural values.

IV. General Norms for IMTech Programmes

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

4.1. Programme Outcomes

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

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and 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 IMTech. programmes and are compulsory for all students enrolled in IMTech. 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 IMTech. in that branch.
3.	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.
4.	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.
5.	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.
6.	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.
7.	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.
8.	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 IMTech. The curriculum includes provisions for students to pursue courses in 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. These variants have been carefully

designed to help students develop into well-rounded professionals, guided by experienced faculty.

6.1. Overall iMTech Programme Structure

Semester	Duration	Credits	Course Details
Semester 1	(15 weeks)	20 credits	7 core courses
Semester 2	(15 weeks)	20 credits	6 core courses (1 of the core courses is only a half-semester course)
Semester 3	(15 weeks)	20 credits	6 core courses (1 of the core courses is only a half-semester course)
Semester 4	(15 weeks)	22 credits	4 core courses + 1 Elective from Math and Science Pool
Semester 5	(15 weeks)	24 credits	2 core courses + 4 Electives
Semester 6	(15 weeks)	20 credits	5 Electives
Semester 7	(15 weeks)	20 credits	5 Electives
Semester 8	(15 weeks)	20 credits	5 Electives
Semester 9	(15 weeks)	20 credits	Combination of Project and Courses
Semester 10	(15 weeks)	20 credits	Thesis / Internship
Total		206 Credits	

Note:

One HSS Elective course must be completed by the student to fulfill graduation requirements. This elective can be taken at any time between the 5th and 9th semesters as part of the elective courses. Failure to complete this requirement will result in an inability to graduate on time.

6.2. Course Credit Categories

The total course credits earned over the 10 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
- Master's Thesis / Internship

6.3. *Branch and Specialization*

The term "**branch**" in this document refers to the Integrated M.Tech. (iMTech) degree offered in **Computer Science and Engineering (CSE)**.

The term "**specialization**" refers to sub-areas in which a group of related electives are offered, allowing the student to focus on specific domains. These specializations are suggested based on existing elective courses in the curriculum.

Students may earn up to **two specializations**, which will be reflected in their transcripts.

Note: A student is **not required** to earn a specialization.

6.4. *Categories and Levels*

Courses are classified into distinct levels based on their academic depth and complexity:

- **Level 1** courses are **undergraduate-level** courses.
- **Level 2** and **Level 3** courses are **postgraduate-level** courses, categorized into **basic** and **advanced** levels, respectively.

Note: The credit system is designed to reflect the level of the course. Undergraduate and postgraduate courses follow different credit structures, detailed below.

Table 1: Course Levels and Credit Allocation

Course Level	Interaction Type	Interaction Time	Credits
Level 1 (Undergraduate)	Lecture	1 hour/week for a semester	1 credit
	Tutorial	1 hour/week for a semester	1 credit
	Practical	2 hours/week for a semester	1 credit
Level 2 & 3 (Postgraduate)	Lecture	3 hours/week for a semester	4 credits
	Lecture	2 hours/week for a semester	3 credits

	Practical	2 hours/week for a semester	1 credit
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VII. VII. Category-wise Course Listing

7.1. Category-wise Credit Distribution:

This section contains the course list organized according to the course categories mentioned earlier. Table 2 provides a summary of the overall distribution of courses across various categories.

Table 2: CSE Course Distribution

Computer Science and Engineering (CSE)	
Heads	Credits
Programming	14
Mathematics and Basic Sciences (MBS) Core	20
Humanities and Social Sciences, includes 1 elective	16
Systems	20
CSE Core	20
Branch Electives	24
General Electives (Includes 1 MBS Elective)	52
Combination of Courses and Project (9th Semester)	20
Internship / Thesis	20
Total	206

7.2. Programming

The list of courses under the Programming category is provided in Table 3. All these courses are classified as Level 1 courses.

Table 4: Programming

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

7.3. Mathematics and Basic Sciences

The list of courses under the Mathematics and Basic Sciences category is provided in Table 4. All these courses are Level 1.

Table 4: Mathematics and Basic Sciences

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

7.4. Humanities and Social Sciences

The courses listed in Table 5 are the core courses under the Humanities and Social Sciences category. All these courses are Level 1.

Table 5: 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 Pathways to Information Technology	4	3:1:0:4
Elective in Humanities and Social Sciences	4	3:1:0:4

7.5. Systems

Table 6 contains courses under the Systems category. All these courses are Level 1.

Table 6: 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	4	3:1:0:2
Operating Systems	4	3:0:2:4

7.6. CSE Core

Table 7 contains the core courses for CSE. All these are Level 1 courses.

Table 7: CSE Core

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

7.7. Electives and Branch Electives

In addition to the core courses, students in CSE are required to complete **at least 18 elective courses**, each carrying **4 credits**.

Note: This does **not** include:

- 1 elective from the Humanities and Social Sciences pool
- 1 elective from the Basic Science and Math pool

Electives can be taken from the **5th to the 9th semester**, with additional options in the 9th semester if needed.

Out of these 18 electives:

- **6 electives** will be considered **CSE Branch Electives (BE)**.
- These **must include 3 electives from Theoretical Computer Science** and **3 electives from Systems** specializations.

7.8. Project and Reading Electives

Project Elective (PE):

- A **4-credit** elective
- Involves a **semester-long project** under faculty supervision
- Graded based on project output

Reading Elective (RE):

- A **4-credit** elective
- Involves deep **study and presentation of advanced research material**
- Graded based on understanding and articulation

Notes:

- PEs and REs are **optional**
- A student may take a **maximum of 3 PEs and 3 REs** during the entire program
- Only **1 PE and 1 RE per semester** is allowed
- PEs and REs **do not count as branch electives**

VIII. Specialization

Students of the iMTech programme may *earn a specialization* in specified areas by completing **at least 5 electives** in each domain. Though optional, specialization is *recorded in the final transcript* and determined **at the time of graduation**, based on the concentration of elective choices.

Project Electives (PE) and **Reading Electives (RE)** are **counted** toward specialization requirements.

However, a specialization **must include at least 3 non-PE/RE electives**; one **cannot** fulfill all 5 electives using only PEs or REs.

8.1. Dual Specialization

Dual specialization is **encouraged** for students wishing to broaden their academic horizons. However:

- Courses that fall into **multiple streams are counted only once** (no double-counting).
- To earn dual specialization, **10 distinct electives** must be completed **5 from each area**.
- Each specialization must still meet the requirement of **at least 3 non-PE/RE electives**.

8.2. Available Specializations

Currently, CSE students may specialize in the following areas:

- Theoretical Computer Science (TCS)
- Systems
- Artificial Intelligence and Machine Learning (AIML)

- Networking and Communication (NC)
- VLSI Systems (VLSI)
- Digital Society (DT)

8.3. Branch Electives for CSE Specializations

Table 8: Candidate Branch Electives for TCS and Systems Specializations

Note: This list is subject to change each academic year based on course availability.

TCS Branch Electives	Systems Branch Electives
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 & Block chains	Data Modelling
Topics in Artificial Intelligence	Data Visualization
Concrete Mathematics	NoSQL
Compilers	Software Design Practices
Topics in Computability and Learning	Advanced Database
Programming Languages	Hardware Security
Secure Computation	Distributed Computing
Algorithmic Thinking	--
Algorithms Beyond Certainty	--
Introduction to Formal Verification	--
Exact and Parameterised Algorithms	--
Graph Neural Networks	--

IX. Masters Project / Thesis

1. **9th Semester (20 credits):**
A harmonious mix of advanced courses and/or projects, nourishing the roots of your expertise.
2. **10th Semester (20 credits):**
A **6-month industry project**, where your skills bloom in the real world's sun, bridging theory and practice under the sky of innovation.

X. Other General Courses

In addition to the above, students are also required to pass the following general courses, as specified in Table 9:

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

XI. Course Sequencing for iMTEch (CSE)

The course of sequencing for the CSE branch is given in Table 10 below.

Course Name	Credits	Course Category
SEMESTER 1	20	
Mathematics – 1	4	Mathematics and Basic Sciences
Mathematics – 2	4	Mathematics and Basic Sciences
Programming IA (C)	2	Programming
Programming IB (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
SEMESTER 2	20	
Mathematics – 3	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	20	
Mathematics – 4	4	Mathematics and Basic Sciences
Object Oriented Programming IA (C++)	2	Programming
Object Oriented Programming IB (Java)	2	Programming

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Physics (Theory)	3	Mathematics and Basic Sciences
Physics (Lab)	1	Mathematics and Basic Sciences
Signals and Systems	4	Systems
Discrete Mathematics	4	CSE Core
SEMESTER 4	22	
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
1 Elective in the pool of Maths and Science	4	Mathematics and Basic Sciences
Technical Communication	2	Humanities and Social Sciences
Social Pathways to Information Technology	4	Humanities and Social Sciences
SEMESTER 5	24	
Automata Theory and Computability	4	CSE Core
Software Engineering (Theory)	3	CSE Core
Software Engineering (Lab)	1	CSE Core
Elective-1	4	Elective
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	20	
Elective-15	4	Elective
Elective-16	4	Elective

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Elective-17	4	Elective
Elective-18	4	Elective
Elective-19	4	Elective
SEMESTER 9	20	
Combination of Courses and Project/Thesis	20	Masters Project/Thesis
SEMESTER 10	20	
iMTech Project/Thesis	20	Masters Project/Thesis

(Note: A Humanities and Social Science Elective course must be completed by the student in any semester from the 5th to the 9th semester as a graduation requirement.)

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