# B.Tech.

IN

# COMPUTER SCIENCE AND ENGINEERING

# CURRICULUM

# AND

# SYLLABI OF FIRST YEAR COURSES

(Applicable from 2023 Admission onwards)

**Department of Computer Science and Engineering**
**NATIONAL INSTITUTE OF TECHNOLOGY CALICUT**
Kozhikode - 673601, KERALA, INDIA

# The Program Educational Objectives (PEOs) of B.Tech. in Computer Science and Engineering

| | |
|---|---|
| **PEO1** | Graduates shall have sound knowledge regarding the fundamental principles and techniques in the discipline of Computer Science and Engineering. |
| **PEO2** | Graduates shall have the ability to specify, design, develop and maintain reliable and efficient software. |
| **PEO3** | Graduates shall have the necessary communication and management skills and ethical values to become competent professionals. |

# Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) of B.Tech. in Computer Science and Engineering

| | |
|---|---|
| **PO1** | **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. |
| **PO4** | **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **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. |
| **PO11** | **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

| | |
|---|---|
| **PSO1** | Analyze computational problems and design effective and efficient algorithmic solutions. |
| **PSO2** | Write effective code for implementing algorithmic solutions and use available software tools for the design of efficient software solutions. |

# CURRICULUM

**Total credits for completing B.Tech. in Computer Science and Engineering is 150**

## COURSE CATEGORIES AND CREDIT REQUIREMENTS:

The structure of B.Tech. programmes shall have the following Course Categories:

| Sl. No. | Course Category | Number of Courses | Minimum Credits |
|---|---|---|---|
| 1. | Institute Core (IC) | 8 | 22 |
| 2. | Program Core (PC) and Program Electives (PE) | 24-25 | 82 |
| 3. | Open Electives (OE) | 8 | 24 |
| 4. | Institute Electives (IE) (Entrepreneurship Innovation (EI) + Digital / Automation Technologies (DA) + Humanities, Social Science, Management (HM) ) | 6 | 18 |
| 5. | Activity Credits (AC) | -- | 4 |

## COURSE REQUIREMENTS

The effort to be put in by the student is indicated in the tables below as follows:
**L**: Lecture (One lecture session is of 50 minute duration)
**T**: Tutorial (One tutorial session is of 50 minute duration)
**P**: Practical (One practical session is of one hour duration)
**O**: Outside the class effort / self-study (One unit is of one hour duration)

### 1. INSTITUTE CORE (IC)

#### a) Mathematics

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits |
|---|---|---|---|---|---|---|---|
| 1. | MA1002E | Mathematics I | 3 | 1* | 0 | 5 | 3 |
| 2. | MA1012E | Mathematics II | 3 | 1* | 0 | 5 | 3 |
| 3. | MA2002E | Mathematics III | 3 | 1* | 0 | 5 | 3 |
| 4. | MA2012E | Mathematics IV | 3 | 1* | 0 | 5 | 3 |
| | | **Total** | **12** | **4*** | **0** | **20** | **12** |

*Optional for Students (can be replaced with self-study)

#### b) Basic Sciences

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits |
|---|---|---|---|---|---|---|---|
| 1. | PH1001E | Physics of Materials | 3 | 0 | 0 | 6 | 3 |
| 2. | BT1001E | Biology for Engineers | 3 | 0 | 0 | 6 | 3 |
| | | **Total** | | | | | **6** |

**c) Professional Communication and Professional Ethics**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits |
|---|---|---|---|---|---|---|---|
| 1. | MS1001E | Professional Communication | 3 | 0 | 0 | 6 | 3 |
| 2. | CS2019E | Professional Ethics | 1 | 0 | 0 | 2 | 1 |
| | | **Total** | **4** | **0** | **0** | **8** | **4** |

**2A. PROGRAMME CORE (PC)**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits |
|---|---|---|---|---|---|---|---|
| 1 | CS1001E | Computer Programming | 3 | 0 | 0 | 6 | 3 |
| 2 | CS1002E | Introduction to Computing Science | 3 | 0 | 0 | 6 | 3 |
| 3 | CS1003E | Discrete Structures I | 3 | 0 | 0 | 6 | 3 |
| 4 | CS1091E | Programming Laboratory | 0 | 0 | 3 | 3 | 2 |
| 5 | CS1011E | Program Design | 3 | 0 | 0 | 6 | 3 |
| 6 | CS1012E | Logic Design | 3 | 0 | 0 | 6 | 3 |
| 7 | CS1013E | Discrete Structures II | 3 | 0 | 0 | 6 | 3 |
| 8 | CS1092E | Program Design Laboratory | 1 | 0 | 3 | 5 | 3 |
| 9 | CS2001E | Data Structures and Algorithms | 3 | 1 | 2 | 6 | 4 |
| 10 | CS2002E | Computer Organization | 3 | 1 | 2 | 6 | 4 |
| 11 | CS2091E | Data Structures and Algorithms Laboratory | 1 | 0 | 3 | 5 | 3 |
| 12 | CS2092E | Hardware Laboratory | 1 | 0 | 3 | 5 | 3 |
| 13 | CS2011E | Database Management System | 3 | 1 | 2 | 6 | 4 |
| 14 | CS2012E | Operating Systems | 3 | 1 | 2 | 6 | 4 |
| 15 | CS2013E | Theory of Computation | 3 | 0 | 0 | 6 | 3 |
| 16 | CS3001E | Computer Networks | 3 | 1 | 2 | 6 | 4 |
| 17 | CS3002E | Compiler Design | 3 | 1 | 2 | 6 | 4 |
| 18 | CS3003E | Design and Analysis of Algorithms | 3 | 1 | 2 | 6 | 4 |
| 19 | CS3011E | Software Engineering | 3 | 1 | 2 | 6 | 4 |
| 20 | CS3012E | Artificial Intelligence | 3 | 1 | 2 | 6 | 4 |
| 21 | CS3099E | Project | 0 | 0 | 0 | 9 | 3 |
| 22 | CS4097E | Summer Internship | - | - | - | * | 2 |
| | | **Total** | **-** | **-** | **-** | **-** | **73** |

** Decided by the organisation in which the internship is done*

## 2B. LIST OF ELECTIVES

Following elective courses may be credited under the categories mentioned in the table below.

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Additional Categories | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | PE | EI | DA | HM |
| 1. | CS4021E | Logic for Computer Science | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 2. | CS4022E | Program Analysis | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 3. | CS4023E | Formal Semantics | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 4. | CS4024E | Computational Complexity | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 5 | CS4025E | Formal Verification | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 6 | CS4026E | Vehicular Networks: Theory to Practice | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 7 | CS4027E | Computational Geometry | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 8 | CS4029E | Principles of Programming Languages | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 9 | CS4030E | Foundations of Programming | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 10 | CS4031E | Network Security | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 11 | CS4032E | Computer Security | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 12 | CS4033E | Quantum Computation | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 13 | CS4034E | Advanced Computer Networks | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 14 | CS4035E | Probabilistic Methods in Combinatorics | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 15 | CS4036E | Algorithms in Optimization | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 16 | CS4037E | Algorithmic Graph Theory | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 17 | CS4038E | Computational Algebra | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 18 | CS4039E | Computer Architecture | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 19 | CS4040E | Mathematical Foundations of Machine Learning | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 20 | CS4041E | Introduction to Machine Learning | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 21 | CS4042E | Randomized Algorithms | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 22 | CS4043E | Introduction to Parameterized Algorithms | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | CS4044E | Introduction to Parameterized Complexity Theory | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 24 | CS4045E | Image Processing | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 25 | CS4046E | Deep Learning for Computer Vision | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 26 | CS4047E | Advanced Computer Architecture and Security | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 27 | CS4048E | Cloud Computing | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 28 | CS4049E | Distributed Computing | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 29 | CS4050E | Natural Language Processing | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 30 | CS4051E | Introduction to Bioinformatics | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 31 | CS4052E | Number Theory and Cryptography | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 32 | CS4053E | Data Mining | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 33 | CS4054E | Embedded Systems | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 34 | CS4055E | Object Oriented Systems | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 35 | CS4056E | Approximation Algorithms | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 36 | CS4057E | Data Privacy | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 37 | CS4058E | Coding Theory | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 38 | CS4059E | Term Paper | 3 | 0 | 0 | 6 | 3 | Y | N | Y | N |
| 39 | CS4080E | Operating Systems Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 40 | CS4081E | Compiler Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 41 | CS4082E | Digital Design Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 42 | CS4083E | Database System Design Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 43 | CS4084E | Networks Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 44 | CS4085E | Software Engineering Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 45 | CS4086E | Systems Programming Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 46 | CS4087E | Computer Security Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 47 | CS4088E | Object Oriented Systems Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 48 | CS4089E | Machine Learning Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | CS4090E | Image Processing Laboratory | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 50 | CS4091E | Processor Design Lab | 1 | 0 | 3 | 5 | 3 | Y | N | Y | N |
| 51 | CS4098E | Project | 0 | 0 | 0 | 9 | 3 | Y | N | N | N |
| 52 | CS4099E | Project | 0 | 0 | 0 | 27* | 9 | Y | N | N | N |

** Decided by the organisation in which the project is done, if carried out outside the Institute.*

## 3. OPEN ELECTIVES (OE)

Courses offered by other Departments / Schools / Centres or Institute Approved Online Platforms, with a limit on the maximum number of courses from such platforms specified as per B.Tech. Ordinances and Regulations. In addition, all PE courses except Projects offered by CSE shall be permitted to be included in this category for students of B.Tech. CSE.

## 4. INSTITUTE ELECTIVES (IE)

In case of the Institute Electives, courses in the appropriate categories offered by other departments/schools/centres also can be credited instead of the courses offered by the Computer Science & Engineering Department, subject to the approval from the Course Faculty and Faculty Advisor.

### a) Entrepreneurship / Innovation Basket (EI):

Courses proposed by the Departments/Schools/Centres and approved by Institute Innovation Council. Total credits required is 3.

### b) Digital Automation Technologies (DA):

Courses related to programming / automation tools & techniques / Industry 4.0. These courses may be proposed by Departments/Schools/Centres and approved by the Senate to be included in the DA category. Total credits required is 6. All of CSE's PEs can be credited as DA electives too.

### c) Humanities, Social Science, Management (HM):

Courses such as Indian and Foreign languages, Economics, Engineering Management, Financial Management and Design Thinking. These courses may be proposed by Departments/Schools/Centres and approved by the Senate to be included in HM category. Total credits required is 9.

## 5. ACTIVITY CREDITS (AC)

A minimum of 80 Activity Points are to be acquired for obtaining the 4 Activity Credits required in the curriculum.
Activity points acquired should be a minimum of 20 at the end of S4.
Activity points acquired should be a minimum of 40 at the end of S6.

## 6. MINOR COURSES (MC)

Applicable only for those students opting for the minor programme. A total of four courses (12-16 credits) are required to be credited from $4^{th}$ semester to $7^{th}$ semester.

# PROGRAMME STRUCTURE

**Semester I**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | MA1002E | Mathematics I | 3 | 1* | 0 | 5 | 3 | IC |
| 2. | MS1001E | Professional Communication | 3 | 1* | 0 | 5 | 3 | IC |
| 3. | CS1001E | Computer Programming | 3 | 0 | 0 | 6 | 3 | PC |
| 4. | CS1002E | Introduction to Computing Science | 3 | 0 | 0 | 6 | 3 | PC |
| 5. | CS1003E | Discrete Structures I | 3 | 0 | 0 | 6 | 3 | PC |
| 6. | CS1091E | Programming Laboratory | 0 | 0 | 3 | 3 | 2 | PC |
| | | **Total** | | | | | **17** | -- |

**Semester II**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | MA1012E | Mathematics II | 3 | 1* | 0 | 5 | 3 | IC |
| 2. | PH1001E | Physics of Materials | 3 | 0 | 0 | 6 | 3 | IC |
| 3. | BT1001E | Biology for Engineers | 3 | 0 | 0 | 6 | 3 | IC |
| 4. | CS1011E | Program Design | 3 | 0 | 0 | 6 | 3 | PC |
| 5. | CS1012E | Logic Design | 3 | 0 | 0 | 6 | 3 | PC |
| 6. | CS1013E | Discrete Structures II | 3 | 0 | 0 | 6 | 3 | PC |
| 7. | CS1092E | Program Design Laboratory | 1 | 0 | 3 | 5 | 3 | PC |
| | | **Total** | | | | | **21** | -- |

**Semester III**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | MA2002E | Mathematics III | 3 | 1* | 0 | 5 | 3 | IC |
| 2. | CS2001E | Data Structures and Algorithms | 3 | 1 | 2 | 6 | 4 | PC |
| 3. | CS2002E | Computer Organization | 3 | 1 | 2 | 6 | 4 | PC |
| 4. | | EI Elective | 3 | 0 | 0 | 6 | 3 | EI |
| 5. | CS2091E | Data Structures and Algorithms Laboratory | 1 | 0 | 3 | 5 | 3 | PC |
| 6. | CS2092E | Hardware Laboratory | 1 | 0 | 3 | 5 | 3 | PC |
| | | **Total** | | | | | **20** | -- |

* Optional for students (can be replaced with self-study)

**Semester IV**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | MA2012E | Mathematics IV | 3 | 1* | 0 | 5 | 3 | IC |
| 2. | CS2011E | Database Management Systems | 3 | 1 | 2 | 6 | 4 | PC |
| 3. | CS2012E | Operating Systems | 3 | 1 | 2 | 6 | 4 | PC |
| 4. | CS2013E | Theory of Computation | 3 | 0 | 0 | 6 | 3 | PC |
| 5. | CS2019E | Professional Ethics | 1 | 0 | 0 | 2 | 1 | IC |
| 6. | | DA Elective - 1 | 3 | 0 | 0 | 6 | 3 | DA |
| 7. | | Minor Course - 1 | 3 | 0 | 0 | 6 | 3 | MC |
| **Total** (Excluding the Minor Courses) | | | | | | | **18** | -- |

* Optional for students (can be replaced with self-study)

**Semester V**

| Sl. No | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | CS3001E | Computer Networks | 3 | 1 | 2 | 6 | 4 | PC |
| 2. | CS3002E | Compiler Design | 3 | 1 | 2 | 6 | 4 | PC |
| 3. | CS3003E | Design and Analysis of Algorithms | 3 | 1 | 2 | 6 | 4 | PC |
| 4. | | Humanities Elective - 1 | 3 | 0 | 0 | 6 | 3 | HM |
| 5. | | DA Elective - 2 | 3 | 0 | 0 | 6 | 3 | DA |
| 6. | | Minor Course - 2 | 3 | 0 | 0 | 6 | 3 | MC |
| **Total** (Excluding the Minor Courses) | | | | | | | **18** | -- |

**Semester VI**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | CS3011E | Software Engineering | 3 | 1 | 2 | 6 | 4 | PC |
| 2. | CS3012E | Artificial Intelligence | 3 | 1 | 2 | 6 | 4 | PC |
| 3. | | Humanities Elective - 2 | 3 | 0 | 0 | 6 | 3 | HM |
| 4. | | Open Elective - 1 | 3 | 0 | 0 | 6 | 3 | OE |
| 5. | | Open Elective - 2 | 3 | 0 | 0 | 6 | 3 | OE |
| 6. | CS3099E | Project | 0 | 0 | 0 | 9 | 3 | PC |
| 7. | | Minor Course - 3 | 3 | 0 | 0 | 6 | 3 | MC |
| **Total** (Excluding the Minor Courses) | | | | | | | **20** | -- |

**Semester VII**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | | Humanities Elective - 3 | 3 | 0 | 0 | 6 | 3 | HM |
| 2. | | Open Elective - 3 | 3 | 0 | 0 | 6 | 3 | OE |
| 3. | | Open Elective - 4 | 3 | 0 | 0 | 6 | 3 | OE |
| 4. | | Open Elective - 5 | 3 | 0 | 0 | 6 | 3 | OE |
| 5. | | Open Elective - 6 | 3 | 0 | 0 | 6 | 3 | OE |
| 6. | CS4097E | Summer Internship | - | - | - | # | 2 | PC |
| 7. | CS4098E / | Project / Programme Elective - 1 | - | - | - | - | 3 | PE |
| 8. | | Minor Course - 4 | 3 | 0 | 0 | 6 | 3 | MC |
| **Total** (Excluding the Minor Courses) | | | | | | | **20** | **--** |

**#** CS4097E Summer Internship (including the academic internship) is to be completed during the vacation after S6, and the evaluation will be done in S7. Working hours will be decided by the organization in which the internship is done.

**Semester VIII**

| Sl. No. | Course Code | Course Title | L | T | P | O | Credits | Category |
|---|---|---|---|---|---|---|---|---|
| 1. | CS4099E / | Project / Programme Elective - 2, Programme Elective - 3 | - | - | - | - | 6 | PE |
| 2. | | Open Elective - 7 | 3 | 0 | 0 | 6 | 3 | OE |
| 3. | | Open Elective - 8 | 3 | 0 | 0 | 6 | 3 | OE |
| 4. | CS4096E | Activity Credits (minimum of 80 points) | - | - | - | - | 4 | AC |
| **Total** | | | | | | | **16** | **--** |

## MA1002E MATHEMATICS I

Pre-requisites: Nil

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 1 | 0 | 5 | 3 |

**Total Lecture sessions: 39**

**Course Outcomes:**

CO1: Find the limits, check for continuity and differentiability of real valued functions of one variable.
CO2: Find the limits, check for continuity and differentiability of real valued functions of two variables.
CO3: Find the maxima and minima of real valued functions of one variable or two variables.
CO4: Find the parametric representation of curves and surfaces in space and evaluate integrals over curves and surfaces.

Functions of one variable: limit, continuity, differentiability, local maxima and local minima, mean value theorems, Taylor's theorem, L'hôpital's rule, integration, fundamental theorem of calculus, volume, area, improper integrals, Gamma and Beta functions. Parameterised curves in space, arc length, tangent and normal vectors, curvature and torsion.

Functions of several variables: limit, continuity, partial derivatives, partial differentiation of composite functions, directional derivatives, gradient, local maxima and local minima of functions of two variables, critical point, saddle point, Taylor's formula for two variables, Hessian, second derivative test, method of Lagrange multipliers. Evaluation of double integrals, improper integrals, change of variables, Jacobian, polar coordinates, triple integral, cylindrical and spherical coordinates, mass of a lamina, centre of gravity, moments of inertia.

Vector field: divergence, curl, identities involving divergence and curl, scalar potential.
Line integral, independence of path, irrotational and solenoidal vector fields, Green's theorem for plane, parameterized surface, surface area and surface integral, flux, Gauss' divergence theorem, Stokes' theorem.

**References:**

1. H. Anton, I. Bivens and S. Davis, *Calculus, 10th ed*, New York: John Wiley & Sons, 2015.
2. G. B. Thomas, M. D. Weirand and J. Hass, *Thomas' Calculus*, 12th ed, New Delhi, India: Pearson Education, 2015.
3. E. Kreyszig, *Advanced Engineering Mathematics,* 10th ed, New York: John Wiley & Sons, 2015.
4. T. M. Apostol, *Calculus Vol 1,* 1st ed. New Delhi: Wiley, 2014.

## MS1001E PROFESSIONAL COMMUNICATION

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 1 | 0 | 5 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Distinguish the role and purpose of communication at the workplace and for academic purposes.
CO2: Decide strategies and modes for effective communication in a dynamic workplace.
CO3: Combine multiple approaches for successful and ethical information exchange.
CO4: Estimate best communication practices to assist productivity and congeniality at the workplace.

**Listening and Reading Comprehension**

Conversation starters: introductions and small talk - Seek and provide information, clarification, polite enquiries, requests, congratulate people, apologise, give and respond to feedback - Describe graphs, tables, and charts - Words often confused: Lexicon and Meaning - Sense Groups - Listening for specific purposes: Listening to lectures, Summarise academic lectures for note-taking - Appropriate Language to Request and Respond - Public Speaking

**Vocabulary and Speaking**

Developing professional vocabulary - Basic Sentence Structures from Reading Texts - Concord - Functions of Auxiliary Verbs and Modals - Strategies for Effective Reading - Skimming and Scanning, Determine themes and main ideas, Predicting content using photos, images and titles - Critical Reading: Discussing and Summarising text points - Understanding Text Structures: sequencing, comparing and contrasting, relating cause and effect, problems and problem-solving - Discussing Rhetorical and Cultural Aspects in Texts - Text Appreciation: Drawing inferences, Framing Opinions and Judgments on Reading Text

**Effective Writing**

Note Making and Summarising: Prepare notes from reading texts, Paraphrasing - Use of Multimedia for Assistive Purposes - Paragraph Writing: cohesive devices to connect sentences in a paragraph - transitional devices - Use Text Structures in Paragraphs: sequencing, comparing and contrasting, relating cause and effect, problems and problem-solving - Avoiding Ambiguity and Cleft Sentences - Applications- Writing Instructions, Descriptions and Explanations - Official Letters of Request and Denial - Official E-mails - Abstract Writing - Digital Resources for Effective Communication

**Communication at Workplace**

Communication Theory - Process of Communication - Modes of Communication - Verbal and Non-Verbal Communication - Tone in Communication - Formal and Informal Communication at Workplace - Passive, Assertive and Aggressive Styles of Communication - Positive Body Language - Group Discussions - Presentation - Workplace Communication - Active Listening - Giving Feedback - Communication Etiquette - Persuasion - Negotiation - Tone and Voice - Telephone etiquette - Establishing Credibility in Conversations - Digital Communication and Netiquette: Conducting Oneself in Virtual Interactions, Constructive use of Social media - Ethical and Culturally Sensitive Communication: Ethical considerations in professional communication, Addressing diversity, Inclusive Communication Practices

**References:**

1. Bhatnagar, N. and Bhatnagar, M., *Communicative English for engineers and professionals*, Dorling Kindersley, 2010.
2. Foley, M. and Hall, D., *Longman advanced learners' grammar: A self-study reference & practice book with answers*, Pearson Education, 2018.
3. Garner, B. A., *HBR Guide to better business writing: Engage readers, tighten and Brighten, make your case*, Harvard Business Review Press, 2012.
4. Hewings, M., *Advanced grammar in use: A reference and practice book for Advanced learners of English*. Cambridge University Press, 2013.

5. Ibbotson, M., Cambridge *English for Engineering*. Cambridge University Press, 2015.
6. Kumar, S. and Lata, P., *Communication Skills*. Oxford University Press, 2015.
7. Sudarshana, N. and Savitha, C., *English for Technical Communication*. Cambridge English, 2016.

## CS1001E COMPUTER PROGRAMMING

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Analyse a computational problem and design approaches for solving it
CO2: Design algorithms for simple computational problems
CO3: Illustrate algorithmic solutions in the C programming language.

**Introduction to Computing**
Fundamentals of Computing: historical perspective, early computers. Formal problem specification, pseudocode and flowcharts. Memory, Variables, Values, Instructions, Programs.

**Data Types, Operators, Expressions and Statements**
Variables and constants - declarations - arithmetic and logical operators Assignment operator Input/output. Control Flow: Statements and blocks if-else, switch, while, for and do-while statements break and continue goto and labels.

**Functions and Program structure**
Basics of functions, Parameter passing, scope rules, recursion.

**Aggregate data types and File Management**
Single and multidimensional arrays, structures and unions, Pointers to arrays and structures -passing arrays and pointers as arguments to functions.
File management - opening and closing files, reading, and writing to files, operations on files.

**References:**

1. B. S. Gottfried, *Programming with C (Schaum's Outline Series)*, 2nd ed. McGraw-Hill, 1996.
2. S. C. Kochan, *Programming in C,* Sams Publishing, 3rd ed. 2004.
3. B. W. Kernighan and D. M. Ritchie, *The C Programming Language,* 2nd ed. UK: Prentice Hall, 1988.
4. W. Kernighan and B. Pike, *The Practice of Programming*, UK: Addison-Wesley, 1999
5. H. M. Deitel and P. J. Deitel, *C: How to program,* 8th ed. Pearson Education, 2015.
6. P. Prinz and T. Crawford, *C in a Nutshell: The Definitive Reference*, 2nd ed., O'Reilly Media, 2016.

## CS1002E INTRODUCTION TO COMPUTING SCIENCE

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Illustrate the elements of computing system and representation of data in computing system

CO2: Illustrate the functions and features of system software

CO3: Apply computational thinking skills to analyse and solve problems efficiently and effectively

**Elements of Computing Systems**
Brief introduction to history of computing - Von Neumann Architecture - Data Representation: binary numbering system, representation of numeric, text and image data - Basic logic gates : half adder- Logic gates as building blocks of a computer - Components of a modern computer system : Basics of ALU, Memory and Control Unit Instruction set - Fetch-execute process of assembly code, execution of simple programs like adding two numbers.

**Overview of Systems Software**
Concept of system software - assembly language translation and loading - compilers and language translation, introduction to the general structure of a compiler in brief - operating systems and application interface - user interface - efficient allocation of resources - system security - safe use of resources

**Computational Thinking**
What is Computational Thinking Sample Datasets - Iterator Flowcharts - Variables: Count Sum Average Accumulator - Filtering: Simple Conditions, Compound Conditions, Looking for a data element, Dynamic Conditions (Maximum Minimum) - Data types: Basics - Compound data types: Subtypes - Pseudocode

**References:**

1. G. Michael Schneider and Judith Gersting, *Invitation to computer science*, 1st ed. India: Cengage Learning, 2022.
2. G. Venkatesh and Madhavan Mukund, *Computational Thinking: A Primer for Programmers and Data Scientists*, 1st ed. India: Notion Press, 2021.

## CS1003E DISCRETE STRUCTURES I

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Classify a relation as equivalence relation/partial order/lattice and perform closure operations.

CO2: Formulate and solve recurrence equations describing the complexity of recursive algorithms

CO3: Formulate elementary problems with graphs and identify elementary algorithmic methods to solve them.

**Sets and Relations**

Sets and Relations: countable and uncountable sets, diagonalization, equivalence relations and partitions, posets and lattices, digraph representation for relations, adjacency matrix/list representations, transitive closure computation - Floyd Warshall algorithm.

**Recurrences**

Induction and Counting: mathematical Induction - review and examples, pigeonhole principle and inclusion exclusion principle. Recurrences: inductive formulations and iterative solution methods, applications to analysis of recursive algorithms, solution by the method of generating functions.

**Graph Theory**

Graph Theory: elementary properties of graphs and trees, BFS and DFS algorithms, bipartite graphs and properties, two colouring of bipartite graphs, Eulerian and Hamiltonian graphs, matching and Hall's matching condition, planar graphs and five colour theorem, five colouring algorithm.

**References:**

1. R. P. Grimaldi and B. V. Ramana, *Discrete and Combinatorial Mathematics: An Applied Introduction*, 5th ed. India: Pearson Education, 2006.
2. L. Lovasz, J. Pelikan, and K. Vesztergombi, *Discrete Mathematics: Elementary and Beyond*, 1st ed. Springer, 2003
3. B. Kolman, R. Busby and S. C. Ross, *Discrete Mathematical Structures*, 6th ed. India: Pearson Education, 2015.

## CS1091E PROGRAMMING LABORATORY

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 0 | 0 | 3 | 3 | 2 |

**Total Practical Sessions: 39**

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Demonstrate an ability to work in a UNIX environment

CO2: Demonstrate an ability to develop algorithmic solutions for simple computational problems

CO3: Implement algorithmic solutions using the C programming language

**Syllabus:**

Linux, Editor, Compiler and Debugger - Introduction to C programming - Statements, Assignment statements, Control Statements, Loop Statements - Arrays-Strings - Pointers - Functions - Recursion - Structures and Union - File Input Output

**References:**

1. B. S. Gottfried, *Programming with C (Schaum's Outline Series)*, 2nd ed. McGraw-Hill, 1996.
2. S. C. Kochan, *Programming in C*, Sams Publishing, 3rd ed. 2004.
3. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd ed. UK: Prentice Hall, 1988.
4. W. Kernighan and B. Pike, *The Practice of Programming*, UK: Addison-Wesley, 1999.
5. H. M. Deitel and P. J. Deitel, *C: How to program*, 8th ed. Pearson Education, 2015.
6. P. Prinz and T. Crawford, *C in a Nutshell: The Definitive Reference*, 2nd ed., O'Reilly Media, 2016.

## MA1012E MATHEMATICS II

Pre-requisites: Nil

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 1 | 0 | 5 | 3 |

**Total: 39 Lecture sessions**

**Course Outcomes**

CO1: Acquire sufficient knowledge about convergence of sequences and series and various methods of testing for convergence.
CO2: Solve linear ODEs with constant coefficients.
CO3: Test the consistency of the system of linear equations and solve it.
CO4: Acquire sufficient knowledge about vector spaces, linear transformation and theory of matrices.
CO5: Diagonalise symmetric matrices and use it to find the nature of quadratic forms.

Numerical sequences, Cauchy sequence, convergence of sequences, series, convergence of series, tests for convergence, absolute convergence. Sequence of functions, power series, radius of convergence, Taylor series. Periodic functions and Fourier series expansions, Half-range expansions.

Existence and uniqueness of solution of first order ordinary differential equations (ODEs), methods of solutions of first order ODE, Linear ODE, linear homogeneous second order ODEs with constant coefficients, fundamental system of solutions, Wronskian, linear independence of solutions, method of undetermined coefficients, solution by variation of parameters.

System of linear equations: Gauss elimination method, row echelon form, row space, row rank, existence and uniqueness, homogeneous system, solution space, rank-nullity relation for homogeneous linear system. Abstract vector space, subspace, linear independence and span, basis, dimension, linear transformation, kernel, range, rank-nullity theorem.

Coordinates, matrix representation of linear transformation, base changing rule, eigenspace, diagonalisation of linear operator. Eigenvalues and eigenvectors of a matrix, Cayley-Hamilton theorem, diagonalisation of symmetric matrices, quadratic forms, transformation into principal axes, eigenvalue method of solving system of first order linear ODEs with constant coefficients.

**References:**

1. H. Anton, I. Bivens and S. Davis, *Calculus*, 10th ed. John Wiley & Sons, 2015.
2. T. A. Apostol, *Calculus Vol 1*, 1st ed. New Delhi: Wiley, 2014.
3. E. Kreyszig, *Advanced Engineering Mathematics*, 10th ed. Wiley, 2015.
4. G. Strang, *Differential Equations and Linear Algebra*, Cambridge Press, 2014.
5. S. W. Goode and S. Annin, *Differential Equations and Linear Algebra*, Pearson Prentice Hall, 2007.
6. O. Bretscher. *Linear algebra with applications*, New Delhi: Prentice Hall, 1997.

## PH1001E PHYSICS OF MATERIALS

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Explain the fundamentals of quantum mechanics.

CO2: Apply quantum mechanics to electron in crystals and study the formation of bands in solid.

CO3: Apply quantum mechanics and study the electrical properties of solids.

CO4: Explain conductivity in semiconducting materials and influence of dopants on conductivity.

**Quantum Mechanics**

Wave-particle duality – de Broglie waves – group and phase velocity – Davison-Germer experi- ment – uncertainty principle – properties and significance of wave function – Schrodinger's wave equation – steady state equation, applications to a free particle and particle in a box.

**Band theory of solids**

Electrons in periodic potential – origin of band in solid – Bloch theorem – Kronig-Penny model (qualitative) – E-k diagram for free electron and electrons in periodic potential – one dimensional zone scheme – band gap.

**Electrical conductivity**

Classical electron theory – conductivity – factors affecting resistivity – Quantum mechanical consideration, Fermi energy and Fermi Surface – Fermi distribution function, density of states – Effective mass of electron.

**Semiconductors**

Intrinsic and extrinsic semiconductors – carrier concentration in *n* and *p* types semiconductors – Fermi level – Temperature dependence of electrical conductivity – variation of Fermi level with temperature.

**References:**

1. A. Beiser, *Concepts of Modern Physics (6th Edition)*, McGraw-Hill, 2009.
2. K. Krane, *Modern Physics (4th Indian Edition)*, Wiley, 2021.
3. R. E. Hummel, *Electronic Properties of Materials (4th Edition)*, Springer, 2014.
4. M. A. Wahab, *Solid State Physics – Structure and Properties of Materials (3rd Edition)*, Narosa, 2015.

## BT1001E BIOLOGY FOR ENGINEERS

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Explain the evolutionary basis of life and the structure-function relationship of biomolecules.

CO2: Describe the characteristics of the cellular composition, communication, and principles of genetics.

CO3: Evaluate and apply the biological principles to solve real-world problems related to food, agriculture, and environmental sciences.

CO4: Apply advanced engineering techniques and tools to create medical devices, diagnostics, and therapies.

**Exploring Biology**

Origin of life, Darwinian Evolution, historical perspectives – Structure and function of Biomolecules: carbohydrates (mono-, di-, and poly- saccharides), lipids, proteins (amino acids, peptides), and nucleic acids (DNA & RNA) - central dogma of molecular biology and gene regulation.

**Cell Biology & Genetics**

Cell structure and function: Prokaryotic & Eukaryotic cells – Bioenergetics - Cell communication: Signal Transduction - Cell division: Cell Cycle, Binary fission, Mitosis & Meiosis - Genetics & inheritance: Mendelian Genetics, Chromosomal Aberrations.

**Human Organs & Bio-design**

Brain: Nervous system, Brain-computer interfaces, EEG, Engineering Solutions for nervous disorder – Eye: Vision physiology, Bionic eye – Heart: Cardiac Function, ECG, stents and pacemakers – Lungs: Physiology, Ventilators & Spirometry, Heart-Lung machine – Stem cells and Regenerative Medicine.

**Global Challenges in Medicine, Agriculture and Environment**

Human Diseases, Disorders & Drugs, Biosensors, Biomedical Diagnostics, Vaccines & Antibiotics - Genetic modification of crops, precision farming and sustainable agriculture - Biodegradation and bioremediation of pollutants, biofuels - Recent advances in biology.

**References:**


1. J. B. Reece, L. A. Urry, M. L. Cain, S. A. Wasserman, P. V. Minorsky and R. B. Jackson, *Campbell biology (Vol. 9)*, Boston. Pearson, 2014.
2. S. Thyagarajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, R. W. Thilagaraj, S. Bharathi and M. K. Jaganathan, *Biology for Engineers,* McGraw Hill Education, 2013.
3. R. M. Cummings, W. S. Klug, C. A. Spencer, M. A. Palladino and D. Killian. *Concepts of Genetics*, 12th ed., Pearson, 2019.
4. D. L. Nelson, and N. M. Cox, *Lehninger principles of biochemistry*, 8th ed.. W.H. Freeman, 2021.
5. S. I. Fox, *Human physiology*, 13th. ed. New York, NY: McGraw--Hill, 2011.
6. A. G. Webb, *Principles of biomedical instrumentation.* Cambridge University Press, 2018.
7. A. T. Johnson, *Biology for engineers*, CRC Press, 2011

## CS1011E PROGRAM DESIGN

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Design, analyse and prove the correctness of simple, iterative and recursive algorithms.
CO2: Analyse algorithms for sorting and searching.
CO3: Select appropriate data structure for solving a given problem.

**Searching and Asymptotic Analysis**
Review of Programming Constructs - Conditional, Iterative and Control constructs, Functions, Recursion, Searching - Linear and Binary, correctness and step count analysis, Asymptotic notation for complexity analysis.

**Sorting Algorithms**
Sorting - Insertion and Selection sorts, Divide and conquer, Merge Sort, Quick sort, Linear and External Sorting. Correctness, Analysis and Applications of sorting.

**Basic Data Structures**
Pointers and dynamic memory allocation, Strings manipulation using Multidimensional arrays and pointer arrays, Abstract Data Types, Lists - Singly and doubly linked list, Stacks, Queues using array and pointer based implementations.

**Trees and Hashing**
Introduction to Graphs, Trees, Binary trees, Heaps, Heap Sort and Priority queues. Binary search trees, and traversal algorithm, Hashing - Chaining and open addressing methods

**References:**

1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, *Data Structures and Algorithms*, 1st ed. India: Dorling Kindersly, 2009.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, *Introduction to Algorithms*, 3rd ed. MIT Press, 2009.
3. E. Horowitz, S. Sahni and D. Mehta, *Fundamentals of Data Structures in C++*, 2nd ed. Universities Press, 2008.
4. S. Dasgupta, C. H. Papadimitriou and U. Vazirani. *Algorithms* 1st ed. McGraw-Hill, 2006.

## CS1012E LOGIC DESIGN

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Assess various number systems and apply them in digital design.
CO2: Design logic functions utilising logic gates and programmable logic.
CO3: Design simple digital systems.

**Number theory and boolean algebra**
Number systems and codes, Boolean algebra: postulates and theorems, constants, variables and functions, switching algebra, Boolean functions and logical operations, Karnaugh map: prime cubes, minimum sum of products and product of sums.

**Design and analysis of combinational logic**
Quine-McCluskey algorithm, prime implicant chart, cyclic prime implicant chart, Petrick's method, Combinational Logic: introduction, analysis and design of combinational logic circuits, parallel adders and look-ahead adders, comparators, decoders and encoders, code conversion, multiplexers and demultiplexers, parity generators and checkers

**Design of digital logic devices**
Programmable Logic Devices, ROMs, PALs, PLAs, Introduction to sequential circuits, memory elements, latches

**Design and analysis of sequential logic**
Flip-flops, analysis of sequential circuits, state tables, state diagrams, design of sequential circuits, excitation tables, Mealy and Moore models, registers, shift registers, counters

**References:**

1. T. L. Floyd and R. P. Jain, *Digital Fundamentals*, 8th ed. Pearson Education, 2006.
2. C. H., Roth Jr. and L. L. Kinney, *Fundamentals of Logic Design*, 6th ed. Cengage Learning, 2009.
3. M. M. Mano and M. D. Ciletti, *Digital Design*, 4th ed. Pearson Education, 2008.
4. B. J. LaMeres, *Introduction to Logic Circuits & Logic Design with Verilog*, 1st ed. Springer, 2017.

## CS1013E DISCRETE STRUCTURES II

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| 3 | 0 | 0 | 6 | 3 |

**Total Lecture Sessions: 39**

**Course Outcomes:**

CO1: Formulate and solve problems in propositional/predicate logic and perform formal deductions

CO2: Apply elementary algebraic and number theoretic concepts to solve modular linear equations and related problems.

CO3: Draw elementary probabilistic inferences and compute mathematical expectation in simple algorithmic and combinatorial problems.

**Logic, Sets, and Relations**

Propositional Logic: formulas and truth assignments, logical consequences and deductions, formula equivalences, inference by contradiction and contraposition, resolution algorithm

Predicate Logic: quantifiers, deduction rules, models and satisfiability.

**Algebra and Number Theory**

Algebra: Elementary properties of groups, rings, integral domains and fields - Lagrange's theorem.

Number Theory and Applications: Euclid's algorithm, complexity analysis - solution to congruences, modular exponentiation and inversion, Euler's theorem and Fermat's theorem, Fermat's test for primality.
Chinese remaindering, overview of RSA cryptosystem.

**Probabilistic Method**

Elementary combinatorics - ball- bin problems, discrete probability, conditional probability and probabilistic reasoning - expectation and conditional expectation, probabilistic method, applications to algorithm design - expected and average case analysis.

**References:**

1. R. P. Grimaldi and B. V. Ramana, *Discrete and Combinatorial Mathematics: An Applied Introduction*, 5th ed. India: Pearson Education, 2006.
2. I. M. Copi, *Symbolic Logic*, 5th ed. India: Pearson Education, 2015.
3. K. Ireland and M. Rosen, *A classical Introduction to Modern Number Theory*, 2nd ed. India: Springer, 1990.
4. L. Lovasz, J. Pelikan and K. Vesztergombi, *Discrete Mathematics: Elementary and Beyond*, 1st ed. Springer, 2003.

**CS1092E PROGRAM DESIGN LABORATORY**

Pre-requisites: NIL

| L | T | P | O | C |
|---|---|---|---|---|
| **1** | **0** | **3** | **5** | **3** |

**Total Sessions: 13L + 39P**

**Course Outcomes:**

CO1: Implement fundamental algorithms like sorting and searching.

CO2: Implement basic data structures like list, stack, queue and tree.

CO3: Develop efficient algorithmic solution for a given problem and implement the solution using appropriate data structures.

**Syllabus / List of Experiments:**

**Theory**

Review of Dynamic memory allocation, Pointers, Recursion and File organization. Linear and Binary Search, Insertion Sort and Selection Sort

**Practical**

1. Iterative and recursive algorithms
2. Linear and Binary search implementations
3. Sorting: Insertion sort, Selection sort and Linear sort implementations
4. Quick sort and Merge sort implementations
5. Stack and Queue implementation using arrays and linked list
6. Binary tree representation, Arithmetic expression to postfix
7. Postfix to expression tree, tree traversal and evaluation
8. Heap sort and priority queue implementation
9. Binary search tree - insert, delete and search.

**References:**

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein, *Introduction to Algorithms*, 3rd ed. MIT Press, 2009.
2. E. Horowitz, S. Sahni and D. Mehta, *Fundamentals of Data Structures in C++*, 2nd ed. Universities Press, 2008.
3. M. A. Weiss, *Data structures and algorithm analysis in C++*, 4th ed. Addison-Wesley, Boston, 2014.