

**Re-entry Criteria into Second Year (Third Semester)**

The student who takes an exit after one year with an award of certificate may be allowed to re-enter into third Semester for completion of the BCA Program as per the Institute's schedule after earning requisite credits in the First year.

**Scheme of Studies and Examination**  
**BCA – 3<sup>rd</sup> Semester**  
**(BCA)**  
**w.e.f 2026-27**

| Sr. No.              | Category                     | Course Code         | Course Title                     | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|---------------------|----------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |                     |                                  | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-201B         | Design and Analysis of Algorithm | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 2                    | Core Courses                 | CC-BCA-203B         | Database Management System       | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-205B         | Database Management System Lab   | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC-BCA-207B         | Software Engineering             | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Skill Enhancement Courses    | SEC-BCA-201B        | Python Programming               | 2              | 0 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
|                      |                              | LC-BCA-209B         | Python Programming Lab           | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-201B        | Computer Graphics                | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-211B         | Computer Graphics Lab            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Value Added Courses          | Refer Table No.- II | .....                            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| <b>Total Credits</b> |                              |                     |                                  |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

Students can choose their specialization i.e. Stream with Discipline Specific Elective[DSE] from Second year onwards(Appendix-I).

A minimum of TWENTY students is required to offer any specialization area. The specialization area opted for in the 3<sup>rd</sup> Semester would remain the same in all further semesters.

**Scheme of Studies and Examination**  
**BCA – 3<sup>rd</sup> Semester**  
**(Data Science)**  
*w.e.f 2026-27*

| Sr. No.              | Category                     | Course Code         | Course Title                                   | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|---------------------|------------------------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |                     |                                                | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-201B         | Design and Analysis of Algorithm               | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 2                    | Core Courses                 | CC-BCA-203B         | Database Management System                     | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-205B         | Database Management System Lab                 | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC-BCA-207B         | Software Engineering                           | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Skill Enhancement Courses    | SEC-BCA-201B        | Python Programming                             | 2              | 0 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
|                      |                              | LC-BCA-209B         | Python Programming Lab                         | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-DS-201B     | Basics of Data Analytics using Spreadsheet     | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-DS-203B      | Basics of Data Analytics using Spreadsheet Lab | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Value Added Courses          | Refer Table No.- II | .....                                          | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| <b>Total Credits</b> |                              |                     |                                                |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

**Scheme of Studies and Examination**  
**BCA – 3<sup>rd</sup> Semester**  
**(Artificial Intelligence & Machine Learning)**  
**w.e.f 2026-27**

| Sr. No.              | Category                     | Course Code         | Course Title                     | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|---------------------|----------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |                     |                                  | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-201B         | Design and Analysis of Algorithm | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 2                    | Core Courses                 | CC-BCA-203B         | Database Management System       | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-205B         | Database Management System Lab   | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC-BCA-207B         | Software Engineering             | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Skill Enhancement Courses    | SEC-BCA-201B        | Python Programming               | 2              | 0 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
|                      |                              | LC-BCA-209B         | Python Programming Lab           | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-AIML-201B   | Feature Engineering              | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-AIML-203B    | Feature Engineering Lab          | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Value Added Courses          | Refer Table No.- II | .....                            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| <b>Total Credits</b> |                              |                     |                                  |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

**Scheme of Studies and Examination**  
**BCA – 4<sup>th</sup> Semester**  
**( BCA)**  
**w.e.f 2026-27**

| Sr. No.              | Category                     | Course Code  | Course Title                           | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|--------------|----------------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |              |                                        | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-202B  | Entrepreneurship and Startup Ecosystem | 1              | 1 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
| 2                    | Core Courses                 | CC -BCA-204B | Computer Networks                      | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-206B  | Computer Networks Lab                  | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC -BCA-208B | Probability and Statistics             | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Core Courses                 | CC -BCA-210B | Artificial Intelligence                | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-212B  | Artificial Intelligence Lab            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-202B | Advance Database System                | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-214B  | Advance Database System Lab            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Skill Enhancement Courses    | SEC-BCA-202B | Design Thinking and Innovation         | 1              | 1 | - | 2                   | 2         | 15                           | 35                | -         | 50         |
| <b>Total Credits</b> |                              |              |                                        |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

**Scheme of Studies and Examination**  
**BCA – 4<sup>th</sup> Semester**  
**(Data Science)**  
*w.e.f 2026-27*

| Sr. No.              | Category                     | Course Code     | Course Title                           | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|-----------------|----------------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |                 |                                        | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-202B     | Entrepreneurship and Startup Ecosystem | 1              | 1 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
| 2                    | Core Courses                 | CC -BCA-204B    | Computer Networks                      | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-206B     | Computer Networks Lab                  | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC -BCA-208B    | Probability and Statistics             | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Core Courses                 | CC -BCA-210B    | Artificial Intelligence                | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-212B     | Artificial Intelligence Lab            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-DS-202B | Data Visualization                     | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-DS-204B  | Data Visualization Lab                 | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Skill Enhancement Courses    | SEC-BCA-202B    | Design Thinking and Innovation         | 1              | 1 | - | 2                   | 2         | 15                           | 35                | -         | 50         |
| <b>Total Credits</b> |                              |                 |                                        |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

**Scheme of Studies and Examination**  
**BCA – 4<sup>th</sup> Semester**  
**(Artificial Intelligence & Machine Learning)**  
**w.e.f 2026-27**

| Sr. No.              | Category                     | Course Code       | Course Title                           | Hours per week |   |   | Total Load Per Week | Credits   | Examination Schedule (Marks) |                   |           |            |
|----------------------|------------------------------|-------------------|----------------------------------------|----------------|---|---|---------------------|-----------|------------------------------|-------------------|-----------|------------|
|                      |                              |                   |                                        | L              | T | P |                     |           | Assessment                   | End Semester Exam | Practical | Total      |
| 1                    | Core Courses                 | CC-BCA-202B       | Entrepreneurship and Startup Ecosystem | 1              | 1 | 0 | 2                   | 2         | 15                           | 35                | -         | 50         |
| 2                    | Core Courses                 | CC -BCA-204B      | Computer Networks                      | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-206B       | Computer Networks Lab                  | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 3                    | Core Courses                 | CC -BCA-208B      | Probability and Statistics             | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
| 4                    | Core Courses                 | CC -BCA-210B      | Artificial Intelligence                | 3              | 0 | 0 | 3                   | 3         | 25                           | 50                | -         | 75         |
|                      |                              | LC-BCA-212B       | Artificial Intelligence Lab            | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 5                    | Discipline Specific Elective | DSE-BCA-AIML-202B | Introduction to ML                     | 1              | 0 | 0 | 1                   | 1         | 05                           | 20                | -         | 25         |
|                      |                              | LC-BCA-AIML-204B  | Introduction to ML Lab                 | 0              | 0 | 4 | 4                   | 2         | 15                           | -                 | 35        | 50         |
| 6                    | Skill Enhancement Courses    | SEC-BCA-202B      | Design Thinking and Innovation         | 1              | 1 | - | 2                   | 2         | 15                           | 35                | -         | 50         |
| <b>Total Credits</b> |                              |                   |                                        |                |   |   |                     | <b>20</b> |                              |                   |           | <b>500</b> |

**Semester-III**

**Table No. II (Value Added Courses)**

| S. No. | Category            | Course Code | Course Title              |
|--------|---------------------|-------------|---------------------------|
| 1      | Value Added Courses | VAC-201B    | Disaster Management       |
| 2      | Value Added Courses | VAC-203B    | Yoga and Physical Fitness |
| 3      | Value Added Courses | VAC-205B    | Sports Management         |

**Notes:**

1. At the end of the Fourth Semester every student shall undergo Summer Training /Internship/ Capstone for Eight Weeks in the industry/Research or Academic Institute. This component will be evaluated during the fifth semester.
2. An **UNDER GRADUATE DIPLOMA IN COMPUTER APPLICATION** will be awarded, if a student wishes to exit at the end of Second year.

**Exit Criteria after Second Year of BCA Programme**

Students will have the option to exit the Bachelor of Computer Application (BCA) program after successfully completing the second year . Upon exit, they will be awarded a **UG Diploma in Computer Application**. To be eligible for this diploma, students must complete an additional 04 credits in one of the following areas:

1. **Skill-Based Subject:** A specialized course aimed at enhancing technical and practical expertise in computer applications.
2. **Work-Based Vocational Course:** A vocational course offered during the summer term, focused on building practical, industry-relevant skills.
3. **Internship/Apprenticeship:** A professional internship or apprenticeship with a minimum duration of 08 weeks, conducted after the fourth semester, offering hands- on experience in a relevant field.
4. **Social Responsibility & Community Engagement:** Involvement with an NGO or community-based organization for a minimum of 08 weeks, contributing to social initiatives and applying computer application knowledge to solve real-world challenges.
5. **Capstone Project:** Completion of a capstone project integrating the skills and knowledge gained during the first two years of the program, which can be an independent or group project.

The specific mode of completing the additional credits will be decided by the Institute and students will be required to complete the 08-week program or project during the summer term following their fourth semester.

Students opting for this exit will also be required to **submit an Internship/Apprenticeship Report** or complete the Capstone Project as per the schedule outlined by the Institute before they are awarded the UG Diploma.

# **SEMESTER-III**

**(Syllabi of Common Courses for all streams )**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | CC-BCA-201B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |   |         |              |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |              |
| Course Title             | Design and Analysis of Algorithms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | T | P | Credits | Semester-III |
|                          | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 | 0 | 3       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of algorithms, including time and space complexity and asymptotic notations.</li><li>• To understand algorithm design techniques such as divide and conquer, greedy method, and dynamic programming along with their applications.</li><li>• To understand graph algorithms, backtracking techniques, and the basics of computational complexity including P, NP, NP-complete, and NP-hard problems.</li></ul> |   |   |         |              |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                                                                      | RBT Level             |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>CO1</b> | <b>Define</b> fundamental concepts of algorithms, including time and space complexity, asymptotic notations, and analysis of basic algorithms such as searching, sorting, and recursion. | Level-1<br>Remember   |
| <b>CO2</b> | <b>Explain</b> divide and conquer and greedy design techniques and their applications in sorting, searching, shortest path problems, and minimum spanning trees.                         | Level-2<br>Understand |
| <b>CO3</b> | <b>Apply</b> dynamic programming and graph algorithms to solve problems such as shortest paths, knapsack, and graph traversal techniques.                                                | Level-3 Apply         |
| <b>CO4</b> | <b>Analyze</b> backtracking methods and computational complexity concepts including P, NP, NP-complete, and NP-hard problem classes.                                                     | Level-4 Analyze       |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

## Unit -I

**Algorithm:** Definition of algorithm, Design and performance analysis of algorithms, time complexity, space complexity.

Asymptotic notations ( $O$ ,  $\Omega$ ,  $\Theta$ ) to measure growth of a function and application to measure complexity of algorithms.

Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication.

**Recursion:** Basic concept. Analysis of recursive algorithms, Master's theorem.

## Unit- II

### **The Divide & Conquer Design Technique:**

The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication.

Lower bound for comparison-based sorting.

### **The Greedy Design Technique:**

The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.

## Unit- III

### **The Dynamic Programming Design Technique:**

The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem.

**Algorithms on Graphs:** Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

## Unit -IV

### **Limitations of Algorithmic Power:**

Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem.

Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.

### **Suggested Readings:**

- Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
- Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.
- Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.
- Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012
- Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
- Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.

### **Useful Video links:**

| Unit No. | Topics                                        | Links                                                                                     |
|----------|-----------------------------------------------|-------------------------------------------------------------------------------------------|
| 1        | Design and performance analysis of algorithms | <a href="https://nptel.ac.in/courses/106101060">https://nptel.ac.in/courses/106101060</a> |
| 2        | The Greedy Design Technique                   | <a href="https://nptel.ac.in/courses/106106131">https://nptel.ac.in/courses/106106131</a> |
| 3        | The Dynamic Programming Design Technique      | <a href="https://nptel.ac.in/courses/106101060">https://nptel.ac.in/courses/106101060</a> |
| 4        | NP-Complete                                   | <a href="https://nptel.ac.in/courses/106101060">https://nptel.ac.in/courses/106101060</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |              |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | CC-BCA-203B                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |              |
| Course Title             | Database Management Systems                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                               | T | P | Credits | Semester-III |
|                          | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0 | 0 | 3       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of databases, DBMS, data models, and database design principles.</li><li>• To gain knowledge of relational algebra, SQL, normalization, and transaction management for effective database handling.</li><li>• To study advanced database technologies including NoSQL, Big Data, indexing, and database security concepts.</li></ul> |   |   |         |              |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                                                                     | RBT Level             |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>CO1</b> | Define the basic concepts of data, database, DBMS, data models, keys, constraints, relational model, SQL, normalization, transactions, indexing, NoSQL, Big Data and database security. | Level-1<br>Remember   |
| <b>CO2</b> | Explain database applications, data models, ER diagrams, SQL, normalization, transactions, indexing, NoSQL, CAP theorem, and security.                                                  | Level-2<br>Understand |
| <b>CO3</b> | Apply relational algebra, SQL queries, normalization techniques, and indexing methods to solve database problems.                                                                       | Level-3<br>Apply      |
| <b>CO4</b> | Analyze database designs, transaction concurrency control, indexing strategies, and NoSQL versus relational database systems.                                                           | Level-4<br>Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction to Databases:** Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators.

**Data Models:** Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS.

**Database Design:** Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema.

## Unit-II

**Relational Algebra and Calculus:** Introduction to Relational Algebra, Operations:

Selection, Projection, Set Operations, Join Operations, Division, Tuple and Domain Relational Calculus

**Structured Query Language (SQL):** SQL Basics: DDL and DML, Aggregate Functions (Min( ), Max( ), Sum( ), Avg( ), Count( ) ), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses (Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join

**Advanced SQL:** Analytical queries, Hierarchical queries, Recursive queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL.

Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.

## Unit-III

**Transaction Management :** ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Supporting SQL, Introduction to Crash Recovery, 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlocks.

**Database Storage and Indexing:** Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection.

## Unit-IV

**No SQL Databases and Big Data:** Introduction to No SQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, Mongo DB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.

**Database Security and Advanced Topics:** Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Warehousing, OLAP, Data Mining

### Suggested Readings:

- Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, third edition, McGraw–Hill, 2018
- Benjamin Rosenzweig, Elena Rakhimov, “Oracle PL/SQL by Example”, fifth edition, Prentice Hall, 2015
- Brad Dayley, “NoSQL with MongoDB in 24Hours”, 1st edition, Sams Publishing, 2024
- Korth, Silbertz, Sudarshan,” Database System Concepts”, Seventh Edition, McGraw - Hill.(2019)
- R. P. Mahapatra, Govind Verma, “Database Management Systems”, Khanna Publishing House, 2025.

**Useful Video Links:**

| Unit No. | Topics                          | Links                                                                                                         |
|----------|---------------------------------|---------------------------------------------------------------------------------------------------------------|
| Unit-I   | Introduction to Databases       | <a href="https://nptel.ac.in/courses/106105175">https://nptel.ac.in/courses/106105175</a>                     |
| Unit-II  | Structured Query Language (SQL) | <a href="https://youtu.be/w1XdPholzWY?si=vFjC72ql5JQiibX">https://youtu.be/w1XdPholzWY?si=vFjC72ql5JQiibX</a> |
| Unit-III | Transaction Management          | <a href="https://nptel.ac.in/courses/106105175">https://nptel.ac.in/courses/106105175</a>                     |
| Unit-IV  | No SQL Databases and Big Data   | <a href="https://youtu.be/-s29jUAkg70?si=G4iGYPwXyfwc6r">https://youtu.be/-s29jUAkg70?si=G4iGYPwXyfwc6r</a>   |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | LC-BCA-205B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |              |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| Course Title             | Database Management Systems Lab                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• Create and manipulate relational database tables (e.g., Supplier, Part, Supplies) using SQL commands, ensuring data integrity through appropriate constraints.</li><li>• Analyze and retrieve meaningful data by performing JOIN operations and applying aggregate functions to solve real-world database problems.</li><li>• Design and implement complex database systems using ER diagrams, SQL queries, PL/SQL procedures, triggers, and recursion to automate tasks and improve efficiency.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                                                                              | <b>RBT Level</b>    |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>CO1</b> | Apply SQL commands to create and manipulate database tables (e.g., Supplier, Part, Supplies), ensuring data integrity through constraints.                                              | Level-3<br>Apply    |
| <b>CO2</b> | Analyze the relationships between database tables using JOIN operations and aggregate functions to extract meaningful insights (e.g., total quantity supplied, supplier performance).   | Level-4<br>Analyze  |
| <b>CO3</b> | Evaluate the effectiveness of different SQL constraints (e.g., PRIMARY KEY, UNIQUE) and query optimization strategies (e.g., JOIN vs. sub queries) to ensure efficient data management. | Level-5<br>Evaluate |
| <b>CO4</b> | Create PL/SQL procedures, triggers, and recursive queries to automate data handling tasks and build efficient, scalable database systems.                                               | Level-6<br>Create   |

**List of Experiments:**

| <b>Exp. No.</b> | <b>Contents</b>                                                                                           |
|-----------------|-----------------------------------------------------------------------------------------------------------|
| 1.              | Write SQL to create Supplier, Part, and Supplies tables and insert sample data, then display the results. |
| 2.              | Apply ALTER commands to modify the Supplier table (add state, change phone data type).                    |
| 3.              | Write a query to retrieve suppliers from a given city and display their phone numbers.                    |
| 4.              | Use SQL operators to find parts within a specific price range (200–500).                                  |
| 5.              | Perform an INNER JOIN between Supplier and Supplies to display supplier names with supplied quantities.   |
| 6.              | Compare and retrieve distinct branches and analyze how many suppliers belong to each branch.              |

|     |                                                                                                                            |
|-----|----------------------------------------------------------------------------------------------------------------------------|
| 7.  | Write queries using GROUP BY and HAVING to identify branches with more than 2 suppliers.                                   |
| 8.  | Analyze Supplier data to find patterns using LIKE operator (e.g., names starting/ending with specific letters).            |
| 9.  | Differentiate results obtained from INNER JOIN vs LEFT JOIN on Supplier and Supplies tables.                               |
| 10. | Examine part data to determine max, min, and average prices, and interpret differences.                                    |
| 11. | Evaluate which suppliers are most active by analyzing quantity supplied and justify your result.                           |
| 12. | Compare different SQL queries (JOIN vs sub query) to retrieve the same data and determine which is more efficient.         |
| 13. | Assess the impact of updating all supplier cities to “Mumbai” on data consistency.                                         |
| 14. | Judge whether normalization is required in the given schema and justify your reasoning.                                    |
| 15. | Evaluate which constraints (PRIMARY KEY, UNIQUE, CHECK) are most critical for maintaining data integrity in the tables.    |
| 16. | Design an ER diagram for Supplier-Part-Supplies system and convert it into relational tables.                              |
| 17. | Develop a PL/SQL procedure to update supplier details based on input parameters.                                           |
| 18. | Create a trigger that automatically logs changes when part prices are updated.                                             |
| 19. | Design a query to find suppliers who supplied both red and green parts using set operations.                               |
| 20. | Build a small database system (schema + queries) to manage suppliers and parts, including constraints, joins, and reports. |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

#### Useful Video links:

| Experiment name                                                                                                    | Links                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Use SQL operators to find parts within a specific price range (200–500).                                           | <a href="https://youtu.be/IDtI3xN-wm8?si=6CK1VWPdnmy3FScc">https://youtu.be/IDtI3xN-wm8?si=6CK1VWPdnmy3FScc</a> |
| Compare different SQL queries (JOIN vs sub query) to retrieve the same data and determine which is more efficient. | <a href="https://youtu.be/TB5T2O8Hwm8?si=LmkIX22b_j1cT0Bp">https://youtu.be/TB5T2O8Hwm8?si=LmkIX22b_j1cT0Bp</a> |
| Analyze Supplier data to find patterns using LIKE operator (e.g., names starting/ending with specific letters).    | <a href="https://youtu.be/IDtI3xN-wm8?si=UotC1F4Qdd1HxgnY">https://youtu.be/IDtI3xN-wm8?si=UotC1F4Qdd1HxgnY</a> |
| Design an ER diagram for Supplier-Part-Supplies system and convert it into relational tables.                      | <a href="https://youtu.be/5TU7zH0Z8ps?si=vSsEkntFkE1ge0E-">https://youtu.be/5TU7zH0Z8ps?si=vSsEkntFkE1ge0E-</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | CC-BCA-207B                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |              |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |              |
| Course Title             | Software Engineering                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                    | T | P | Credits | Semester-III |
|                          | 3                                                                                                                                                                                                                                                                                                                                                                                                    | 0 | 0 | 3       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• Understand software engineering concepts, process models, and agile methodologies.</li><li>• Learn requirements engineering, risk management, design, testing, and project planning techniques.</li><li>• Gain knowledge of software quality, metrics, release management, and maintenance strategies.</li></ul> |   |   |         |              |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                      | RBT Level          |
|------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | Define software engineering concepts, process models, agile methods, requirements, design, testing, and quality management.              | Level-1 Remember   |
| <b>CO2</b> | Explain software development processes including requirements engineering, risk management, design, testing, and maintenance strategies. | Level-2 Understand |
| <b>CO3</b> | Apply software engineering techniques to develop requirements specifications, design models, and testing strategies.                     | Level-3 Apply      |
| <b>CO4</b> | Analyze software processes, design structures, risk factors, and quality metrics for effective software development.                     | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.

### Unit-II

**Software Requirements Engineering:** Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

**Risk management:** Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.

**Project planning-** Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

### Unit-III

**Design:** Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

**Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

**Product metrics:** Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

### UNIT -IV

**Quality Management:** Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability.

**Release Management:** Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring.

**Product sustenance:** Maintenance, updates, End of life, migration strategies.

#### Suggested Readings:

- Software Engineering, N.S. Gill, Khanna Publishing House 2023 (AICTE Recommended Textbook)
- Software Engineering, Ian Sommerville, 9th edition, Pearson education.
- Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGrawHill Education, 2015.
- Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007
- 2. Software Engineering: Principles and Practice Hans van Vliet
- <https://nptel.ac.in/courses/106101061>

#### Useful Video links

| Unit No. | Topics                      | Links                                                                                     |
|----------|-----------------------------|-------------------------------------------------------------------------------------------|
| 1        | Software Engineering        | <a href="https://nptel.ac.in/courses/106101061">https://nptel.ac.in/courses/106101061</a> |
| 2        | Software Requirements       | <a href="https://nptel.ac.in/courses/106105087">https://nptel.ac.in/courses/106105087</a> |
| 3        | Design & Testing Strategies | <a href="https://nptel.ac.in/courses/106105182">https://nptel.ac.in/courses/106105182</a> |
| 4        | Quality Management          | <a href="https://nptel.ac.in/courses/106101061">https://nptel.ac.in/courses/106101061</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                               |   |   |         |              |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | SEC-BCA-201B                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Category                 | Skill Enhancement Courses                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Course Title             | Python Programming                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                             | T | P | Credits | Semester-III |
|                          | 2                                                                                                                                                                                                                                                                                                                                                                                                                             | 0 | 0 | 2       |              |
| Course Objectives        | <div>The objectives of this course are to<ul style="list-style-type: none"><li>Understand the basics of Python programming, including syntax, data types, strings, and control structures.</li><li>Learn to use functions, modules, data structures, file handling, and exception handling in Python.</li><li>Gain knowledge of data visualization and working with libraries like NumPy for data processing.</li></ul></div> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                                                        | RBT Level          |
|-----|----------------------------------------------------------------------------------------------------------------------------|--------------------|
| CO1 | Define Python programming concepts including syntax, data types, control structures, and functions.                        | Level-1 Remember   |
| CO2 | Explain strings, control flow, functions, data structures, file handling, and exception handling in Python.                | Level-2 Understand |
| CO3 | Apply Python programming constructs such as loops, functions, lists, files, and modules to solve problems.                 | Level-3 Apply      |
| CO4 | Analyze Python programs involving data structures, file operations, exception handling, and data visualization techniques. | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

**Introduction:** History and Application areas of Python ; Structure of Python Program; Identifiers and Keywords; Operators and Precedence; Basic Data Types and type conversion; Statements and expressions; Input/Output statements.

**Strings:** Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings.

### Unit -II

**Control Flow Statements:** Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit.

**Functions:** Built-In Functions, Function Definition and call; Scope and Life time of Variables, Default Parameters, Command Line Arguments; Lambda Functions; Assert statement; Importing User defined module.

### Unit -III

**Mutable and Immutable objects:** Lists, Tuples and Dictionaries; Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as arguments to functions. Using Math and Numpy module for list of integers and arrays.

**Files:** Types of Files; Creating, Reading and writing on Text and Binary Files; The Pickle Module, Reading and Writing CSV Files. Reading and writing of csv and JSON files.

### UNIT- IV

**Exception Handling:** Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions.

**Data visualization:** Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosine curves.

#### Suggested Readings:

- Venkatesh ,NagarajuY ,Introductio intoPython Programming, Khanna Publishing House, 2021.
- Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.
- Sheetal Taneja & Naveen kumar: Python Programming a Modular approach–A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.
- Think Python, by AllenDowney, 2nd edition, 2015, O'Reilly.  
[https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2\\_p4YvMk5cIg/view](https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view)
- An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ.
- Introduction to Computation and Programming using Python, by John Guttag, 2nd edition, 2016, PHI India.

#### Useful Video links:

| Unit No. | Topics                               | Links                                                                                     |
|----------|--------------------------------------|-------------------------------------------------------------------------------------------|
| 1        | <b>Python Programming</b>            | <a href="https://nptel.ac.in/courses/106106145">https://nptel.ac.in/courses/106106145</a> |
| 2        | <b>Control Flow Statements</b>       | <a href="https://nptel.ac.in/courses/103105782">https://nptel.ac.in/courses/103105782</a> |
| 3        | <b>Mutable and Immutable objects</b> | <a href="https://nptel.ac.in/courses/115104095">https://nptel.ac.in/courses/115104095</a> |
| 4        | <b>Exception Handling</b>            | <a href="https://nptel.ac.in/courses/106106212">https://nptel.ac.in/courses/106106212</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |              |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | LC-BCA-209B                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Category                 | Skill Enhancement Courses                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |              |
| Course Title             | Python Programming Lab                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                            | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>Understand and implement basic Python programming concepts including control structures, functions, and data structures.</li><li>Apply Python programming for problem solving using strings, files, NumPy, and exception handling.</li><li>Develop programs for data processing and visualization using Python libraries and built-in functions.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                          | RBT Level        |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | Apply Python programming concepts to solve problems involving control structures, functions, strings, and data structures.                   | Level-3 Apply    |
| <b>CO2</b> | Analyze program requirements involving NumPy operations, file handling, and exception handling to design efficient solutions.                | Level-4 Analyze  |
| <b>CO3</b> | Evaluate different Python implementations for string manipulation, array processing, and data visualization techniques.                      | Level-5 Evaluate |
| <b>CO4</b> | Create Python programs and modules to implement real-world applications using functions, file operations, and graphical data representation. | Level-6 Create   |

**List of Experiments:**

| Exp. No. | Contents                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.       | Write a program to find whether a number is a prime number.                                                                                                                                                                                                                                                                                                                                                         |
| 2.       | Write a program to print m raise to power n, where m and n are read from the user.                                                                                                                                                                                                                                                                                                                                  |
| 3.       | Write a program having a parameterised function that returns True or False depending on whether the parameter passed is even or odd.                                                                                                                                                                                                                                                                                |
| 4.       | Write a program to print the summation of the following series upto n terms: 1-2+3-4+5- 6+7...n                                                                                                                                                                                                                                                                                                                     |
| 5.       | <p>Write a menu driven program to perform the following operations on strings using string built in functions.</p> <ol style="list-style-type: none"> <li>Find the frequency of a character in a string.</li> <li>Replace a character by another character in a string.</li> <li>Remove the first occurrence of a character from a string.</li> <li>Remove all occurrences of a character from a string.</li> </ol> |

|     |                                                                                                                                                                                                                                                                                                                                                                                  |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.  | Write A program that Accepts two strings and returns the indices of all the occurrences of the second string in the first string as a list. If the second string is not present in the first string, then it should return -1                                                                                                                                                    |
| 7.  | Using Numpy module write menu driven program to do following<br>a) Create an array filled with 1's.<br>b) Find maximum and minimum values from an array<br>c) Dot product of 2 arrays.<br>d) Re shape a 1-D array to 2-D array.                                                                                                                                                  |
| 8.  | Write a function that takes as sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count.                                                                                                                                                                                                             |
| 9.  | Consider an tuple t1 = (1,2,5,7,9,2,4,6,8,10). Write a program to perform following operations :<br>a) Print contents of t1 in 2 separate lines such that half values come on one line and other half in the next line.<br>b) Print all even values of t1 as another tuple t2.<br>c) Concatenate tuple t2 = (11,13,15) with t1.<br>d) Return maximum and minimum value from t1.. |
| 10. | Write a function that reads a file file1 and copies only alternative lines to another file file2. Alternative lines copied should be the odd numbered lines.                                                                                                                                                                                                                     |
| 11. | Write a Python program to handle a Zero Division Error exception when dividing a number by zero.                                                                                                                                                                                                                                                                                 |
| 12. | Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.                                                                                                                                                                                                                                                               |
| 13. | Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.                                                                                                                                                                                                                                                                         |
| 14. | Take as input in the months and profits made by a company ABC over a year. Represent this data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total profit.                                                                                                                                                        |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

#### Useful Video links:

| Experiment Name                                                                                                                                                      | Links                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Write a program to print the summation of the following series upto n terms: 1-2+3-4+5- 6+7...n                                                                      | <a href="https://nptel.ac.in/courses/106106145">https://nptel.ac.in/courses/106106145</a> |
| Write a program to find whether a number is a prime number.                                                                                                          | <a href="https://nptel.ac.in/courses/103105782">https://nptel.ac.in/courses/103105782</a> |
| Write a function that takes as sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count. | <a href="https://nptel.ac.in/courses/115104095">https://nptel.ac.in/courses/115104095</a> |
| Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.                                                   | <a href="https://nptel.ac.in/courses/106106212">https://nptel.ac.in/courses/106106212</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | VAC-201B                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| Category                 | Value Added Courses                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Course Title             | Disaster Management                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                          | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                          | 0 | 4 | 2       |              |
| Course Objectives        | The objectives of this course are<br>1. To understand the concepts of disasters, hazards, risks, and vulnerabilities.<br>2. To understand various natural and man-made disasters and their impacts.<br>3. To understand disaster management strategies, including planning, response, and recovery.<br>4. To understand the relationship between development, climate change, and disaster risk reduction. |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                                                   | RBT Level          |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | <b>Recall</b> key concepts of disasters, man-made disaster, disaster management, and their link to development and vulnerability.                                     | Level-1 Remember   |
| <b>CO2</b> | <b>Describe</b> the disaster types, impacts, disaster management phases, disaster risk reduction strategies, policies, legislation, and emergency response mechanisms | Level-2 Understand |
| <b>CO3</b> | <b>Apply</b> the disaster management practices, preparedness planning, risk reduction measures, and emergency response techniques in disasters and crises.            | Level-3 Apply      |
| <b>CO4</b> | <b>Analyze</b> disaster risks, vulnerabilities, management strategies, policies, and emergencies to support effective disaster preparedness and recovery.             | Level-4 Analyze    |

**Note:**

1. All the theoretical contents shall be delivered through the practical workshop mode only. No classroom teaching is encouraged in this course. The list of experiments may be designed by the course coordinator in consultation with the Head of Department.
2. Training and Demonstration Workshops (at least two workshops) be organized in association with the NIDM, NDRF, NCDC, Paramilitary, Fire Brigade, CISF, local administration etc.

## Unit I

**Concepts and Terminologies:** Understanding key concepts of Hazards, disasters; Disaster types and causes (Geophysical, Hydrological, Meteorological, Biological and Atmospheric; Human-made); Global trends in disasters - Impacts (Physical, Social, Economic, Political, Environmental and Psychosocial); Defining Vulnerability (Physical Vulnerability; Economic Vulnerability; Social Vulnerability).

## Unit II

**Key concepts of Disaster Management Cycle:** Components of disaster management cycle (Phases: Response and recovery, Riskassessment, Mitigation and prevention, Preparedness planning, Prediction and warning);Disaster risk reduction (DRR), Community-based disaster risk reduction.

## Unit III

**Initiatives at the National and International level:** Disaster Risk Management in India and at the international level: Related policies, plans,programmes and legislation; International strategy for disaster reduction and otherinitiatives.

## Unit IV

**Emergency Management:** Explosion and accidents (Industrial, Nuclear, Transport and Mining) - Spill (Oil andHazardous material); Threats (Bomb and terrorist attacks) - Stampede and conflicts

### E-Resources

- <http://www.ndma.gov.in/en/>
- <http://nidm.gov.in/>
- <https://www.unisdr.org/>
- <http://www.emdat.be>
- <https://www.weather.gov/safety/>
- <https://www.preventionweb.net/risk/vulnerability>

### Useful Video Links:

| UnitNo.  | Topics                                          | Links                                                                                                                                   |
|----------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Unit-I   | Concept of Hazard                               | <a href="https://nptel.ac.in/courses/105104183">https://nptel.ac.in/courses/105104183</a>                                               |
| Unit-II  | Disaster risk reduction (DRR)                   | <a href="http://acl.digimat.in/nptel/courses/video/124107010/L11.html">http://acl.digimat.in/nptel/courses/video/124107010/L11.html</a> |
| Unit-III | Disaster Risk Management                        | <a href="https://youtu.be/D7CRK7wMamo?si=C_f-j-Lm8g1WgmDa">https://youtu.be/D7CRK7wMamo?si=C_f-j-Lm8g1WgmDa</a>                         |
| Unit-IV  | Condensed Phase Explosives and their Properties | <a href="http://digimat.in/nptel/courses/video/112106177/L34.html">http://digimat.in/nptel/courses/video/112106177/L34.html</a>         |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | VAC-203B                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Category                 | Value Added Courses                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |              |
| Course Title             | Yoga and Physical Fitness                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                            | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• Understand the concepts of yoga, physical fitness, and their importance for a healthy lifestyle.</li><li>• Learn various yogic practices, physical activities, and wellness components for overall development.</li><li>• Gain knowledge of nutrition, weight management and factors affecting physical and mental well-being.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                                            | RBT Level          |
|-----|----------------------------------------------------------------------------------------------------------------|--------------------|
| CO1 | Define concepts of yoga, physical fitness, wellness, and nutrition.                                            | Level-1 Remember   |
| CO2 | Explain yogic practices, physical activities, wellness components, and weight management principles.           | Level-2 Understand |
| CO3 | Apply yoga techniques, physical exercises, and wellness practices for healthy lifestyle development.           | Level-3 Apply      |
| CO4 | Analyze the impact of yoga, fitness activities, wellness factors, and nutrition on physical and mental health. | Level-4 Analyze    |

**Note:**

- All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.
- The list of experiments may be designed by the course coordinator in consultation with the Head of Department.

### Unit-I

**Yoga:** Meaning and definition, Importance of yoga in 21st century, Introduction to Yogic Anatomy and Physiology, Yoga & sports, Yoga for healthy lifestyle,

**Types of Yoga:** Hathayoga, layayoga, mantrayoga, bhaktiyoga, karmayoga, jnanayoga, raj yoga, Study of Chakras, Koshas, Pranas, Nadis, Gunas, Vayus and its application in Yogic practices.

**Ashtang Yoga:** Yama, niyama, asana, pranayama, Pratyahar, dharna, dhyana, Samadhi: Benefits, Utilities & their psychological impact on body and mind. According to yoga concept of normality in modern psychology, concept of personality & its development, yogic management of psycho-somatic ailments: frustration, anxiety, depression

### Unit- II

**Sports for Physical Fitness:** Meaning and definition, Physical Activity– Concept, Benefits of Participation in Physical Activities, Components and Significance of Physical Fitness- Health, Skill and Cosmetic Fitness.

**Types of Physical Activities**—Walking, Jogging, Running, Calisthenics, Rope Skipping, Cycling, Swimming, Circuit Training, Weight training, Adventure Sports, Principles of Physical Fitness, Warming Up, Conditioning, Cooling Down, Methods to Develop and Measure Health and Skill related components of Physical Fitness, Measurement of Health Related Physical Fitness (HRPF)

### Unit-III

**Physical Wellness:** Concept, Components, Types of wellness: psychological, social, emotional, and spiritual. Significance with reference to Positive Lifestyle 2.2, Concepts of Quality of Life and Body Image, Factors affecting Wellness, Wellness Programmes

### Unit-IV

**Nutrition and Weight Management:** Concept of Nutrients, Nutrition, Balanced Diet, Dietary Aids and Gimmicks, Energy and Activity- Calorie Intake, Energy Balance Equation, Obesity- Concept, Causes, Obesity Related Health Problems, Weight Management through Behavioural Modifications

#### Suggested Readings:

- Anand OP. Yog Dawra Kaya Kalp. Sewasth Sahitya Perakashan. Kanpur.
- Brown, J.E. Nutrition Now Thomson-Wadsworth.
- Corbinet. al. Fitness & Wellness- Concepts. McGraw Hill. Publishers. New York. U.S.A
- Corbin, C.B., G.J. Welk, W.R Corbin, K.A. Welk, Concepts of Physical Fitness: Active Lifestyle for Wellness. McGraw Hill, New York, USA.
- Hoeger, WWK and S.A. Hoeger. Principles and Labs for Fitness and Wellness, Thomson Wadsworth, California, USA.
- Hoeger, W.W. & S. Hoeger Fitness and Wellness. 7<sup>th</sup> Ed. Thomson Wadsworth, Boston, USA.
- Kamlesh, M.L. & Singh, M. K.) Physical Education(Naveen Publications).
- Kansal, D.K. Text book of Applied Measurement, Evaluation & Sports Selection. Sports & Spiritual Science Publications, New Delhi.
- Kumari, Sheela, S., Rana, Amita, and Kaushik, Seema,, Fitness, Aerobics and Gym Operations, Khel Sahitya, New Delhi
- Lumpkin, A. Introduction to Physical Education, Exercise Science and Sports Studies, McGraw Hill, New York, U.S.A.
- Savard, M. and C. Svec The Body Shape Solution to Weight Loss and Wellness: The Apples & Pears Approach to Losing Weight, Living Longer, and Feeling Healthier. Atria Books, Sydney, Australia.
- Sri Swami Ramas. Breathing. Sadhana Mandir Trust. Rishikesh.
- Swami Ram Yoga & Married Life Sadhana Mandir Trust. Rishikesh

#### Useful Video links

| Unit No. | Topics                                 | Links                                                                                                           |
|----------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 1        | <b>Types of Yoga</b>                   | <a href="https://youtu.be/wQ8CgB5WURk?si=mhM-bI0ixJbffSHR">https://youtu.be/wQ8CgB5WURk?si=mhM-bI0ixJbffSHR</a> |
| 2        | <b>Sports for Physical Fitness</b>     | <a href="https://youtu.be/8vK7cUj1cyI?si=VDUq1tYMthZG8abr">https://youtu.be/8vK7cUj1cyI?si=VDUq1tYMthZG8abr</a> |
| 3        | <b>Physical Wellness</b>               | <a href="https://nptel.ac.in/courses/110101165">https://nptel.ac.in/courses/110101165</a>                       |
| 4        | <b>Nutrition and Weight Management</b> | <a href="https://youtu.be/vjoeaQlooV4?si=ggo5afV6uOSYorsS">https://youtu.be/vjoeaQlooV4?si=ggo5afV6uOSYorsS</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |              |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | VAC-205B                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Category                 | Value Added Courses                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |
| Course Title             | Sports Management                                                                                                                                                                                                                                                                                                                                                                                               |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                               | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                               | 0 | 4 | 2       |              |
| Course Objectives        | The objectives of this course are to <ul style="list-style-type: none"><li>• Understand the fundamentals of sports management, its structure, governance, and ethical issues.</li><li>• Learn sports marketing, sponsorship, financial management, and event management concepts.</li><li>• Gain knowledge of sports analytics, technology, and their applications in performance and fan engagement.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                        | <b>RBT Level</b>   |
|------------|-------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | Define concepts of sports management, marketing, finance, and sports analytics.                                   | Level-1 Remember   |
| <b>CO2</b> | Explain sports organizational structures, marketing strategies, financial systems, and analytics applications.    | Level-2 Understand |
| <b>CO3</b> | Apply sports management principles in marketing, sponsorship, financial planning, and event management.           | Level-3 Apply      |
| <b>CO4</b> | Analyze sports organizations, marketing strategies, financial models, and performance data using analytics tools. | Level-4 Analyze    |

**Note:**

- All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.
- The list of experiments may be designed by the course coordinator in consultation with the Head of Department.

**Unit-I**

**Introduction to Sports Management:** Definition and scope of sports management, Significance of sports management in society and its evolution over time, Organizational structure of sports: amateur, professional, and non-profit entities, Roles and responsibilities of key personnel: managers, coaches, and agents, Governance bodies in sports: FIFA, IOC, and NCAA, Legal issues: contracts, negotiations, intellectual property rights, Ethical considerations: fair play and doping.

## Unit -II

**Sports Marketing and Sponsorship:** Unique aspects of sports marketing, Fan engagement strategies, Target audience identification and segmentation, Branding strategies for sports teams and athletes, Sponsorship and endorsement deals, Negotiating and managing partnerships,

**Event management:** planning, organizing, and promoting sports events

## Unit -III

**Financial Management in Sports:** Revenue generation in sports: ticket sales, broadcasting rights, merchandise sales, Financial models: budgeting and forecasting, Cost management: player salaries, facility expenses, operational costs, Investment opportunities in sports, Risk management techniques specific to sports organizations.

## Unit -IV

**Sports Analytics and Technology:** Introduction to sports analytics, Evaluating player performance, Devising game strategies, Fan engagement through technology, Analytical techniques: statistical analysis, data visualization, predictive modeling, Key performance indicators (KPIs) in sports, Applications of analytics: talent scouting, injury prevention, performance optimization.

### Suggested Readings:

- Pedersen, P.M., Thibault, L., & Pedersen, P.M. (2019). Contemporary Sport Management. Human Kinetics.
- Hoyer, R., Smith, A.C.T., Nicholson, M., et al. (2021). Sports Management: Principles and Applications. Routledge.
- Chelladurai, P., & Kerwin, S. (2017). Introduction to Sport Management: Theory and Practice. Human Kinetics.
- Hoyer, R., Cuskelly, G., & Nicholson, M. (2019). Sports Governance: A Guide for Sport Organizations. Routledge.
- Conrad, M. (2018). The Business of Sports: A Primer for Journalists. Routledge.
- Shank, M.D. (2019). Sports Marketing: A Strategic Perspective. Pearson.
- Collett, P., & Fenton, W. (2019). The Sponsorship Handbook: Essential Tools, Tips and Techniques for Sponsors and Sponsorship Seekers. Kogan Page.
- Fullerton, S. Jr., & Funk, D.C. (2019). Sports Marketing: A Practical Approach. Routledge.
- Conrad, M. (2019). Winning in Sports Business: Essential Marketing, Finance, and Management Strategies. Routledge.
- McCarty, L.A., & McPherson, G. (2019). Sports Event Management: The Caribbean Experience. Routledge.
- Brown, M.T., Rascher, D., & Leeds, M.A. (2017). Financial Management in the Sport Industry. Routledge.
- Winfree, J.A., & Rosentraub, M.S. (2017). Sports Finance and Management: Real Estate, Entertainment, and the Remaking of the Business. Taylor & Francis.

- Foster, G., O'Reilly, N., & Cuskelly, G. (2018). Sports Business Management: Decision Making Around the Globe. Routledge.
- Brown, M.T., & Shick, D.M. (2019). Financial Management in the Sport Industry. Routledge.
- Conrad, M. (2018). The Business of Sports: A Primer for Journalists. Routledge.
- Alamar, B.C. (2013). Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers. Columbia University Press.
- Miller, T.W. (2019). Sports Analytics and Data Science: Winning the Game with Methods and Models. FT Press.
- Marchi, M., Albert, J., & Baumer, B. (2014). Analyzing Baseball Data with R. Chapman and Hall/CRC.
- Schumaker, R.P., Hwang, R.S.Y., & Chen, H. (2016). Sports Data Mining. Routledge.
- Alamar, B.C. (2013). Sports Analytics: A Guide for Coaches, Managers, and Other Decision Makers. Columbia University Press.

**Useful Video links:**

| Unit No. | Topics                                                   | Links                                                                                     |
|----------|----------------------------------------------------------|-------------------------------------------------------------------------------------------|
| 1        | <b>Sports Management</b>                                 | <a href="https://nptel.ac.in/courses/109105596">https://nptel.ac.in/courses/109105596</a> |
| 2        | <b>Branding strategies for sports teams and athletes</b> | <a href="https://nptel.ac.in/courses/109106403">https://nptel.ac.in/courses/109106403</a> |
| 3        | <b>Risk management techniques</b>                        | <a href="https://nptel.ac.in/courses/109106645">https://nptel.ac.in/courses/109106645</a> |
| 4        | <b>Sports Analytics and Technology</b>                   | <a href="https://nptel.ac.in/courses/109106407">https://nptel.ac.in/courses/109106407</a> |

## Discipline Specific Elective Course (BCA)

|                          |                                                                                                                                                                                                                                                                                                                                                    |   |   |         |              |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | DSE-BCA-201B                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| Category                 | Discipline Specific Elective Courses                                                                                                                                                                                                                                                                                                               |   |   |         |              |
| Course Title             | Computer Graphics                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                  | T | P | Credits | Semester III |
|                          | 1                                                                                                                                                                                                                                                                                                                                                  | 0 | 0 | 1       |              |
| Course Objectives        | The objectives of this course are <ul style="list-style-type: none"><li>• To understand the core concepts, mathematical foundations, and algorithms used in 2D and 3D computer graphics.</li><li>• To explore various techniques including transformations, clipping, shading, and rendering to create and manipulate graphical content.</li></ul> |   |   |         |              |
| Assessment               | 05 Marks                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
| Total                    | 25 Marks                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                  | RBT Level           |
|------------|------------------------------------------------------------------------------------------------------|---------------------|
| <b>CO1</b> | Recall the fundamentals of computer graphics, graphics pipeline, primitives, and coordinate systems. | Level 1: Remember   |
| <b>CO2</b> | Explain 2D graphics concepts, drawing algorithms, transformations, and window–viewport techniques.   | Level 2: Understand |
| <b>CO3</b> | Apply clipping, basic 3D transformations, and projection techniques.                                 | Level 3: Apply      |
| <b>CO4</b> | Analyze lighting, shading, hidden surface removal, and texture mapping techniques.                   | Level 4: Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit-I

Introduction to Computer Graphics, its applications and importance, raster and vector graphics, graphics pipeline and rendering process, graphics primitives, and basic coordinate systems.

### Unit-II

Fundamentals of 2D graphics including pixel operations, RGB color model, line drawing algorithms (DDA and Bresenham), basic 2D transformations (translation, rotation, and scaling), and concepts of window and viewport.

### Unit-III

Introduction to clipping techniques with Cohen–Sutherland line clipping algorithm, fundamentals of 3D graphics, basic 3D transformations, and projection techniques including orthographic and perspective projection.

### Unit-IV

Basics of lighting and shading, hidden surface removal using the Z-buffer algorithm, and introduction to texture mapping and image rendering techniques.

#### Suggested Readings:

- J. F. Hughes, A. van Dam, M. McGuire, D. F. Sklar, and J. D. Foley: Computer Graphics: Principles and Practice, Addison-Wesley.
- D. Shreiner, G. Sellers, J. M. Kessenich, and B. M. Licea-Kane: OpenGL Programming Guide: The Official Guide to Learning OpenGL, Addison-Wesley.
- D. Hearn and M. P. Baker: Computer Graphics with OpenGL, Pearson.
- E. Angel and D. Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, Addison-Wesley.
- F. Klawonn: Introduction to Computer Graphics: Using Java 2D and 3D, Springer.

#### Useful Video Links:

| Unit No. | Topics                            | Links                                                                                                                                         |
|----------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Unit-I   | Introduction to Computer Graphics | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec1.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec1.html</a>   |
|          | Raster Graphics                   | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec2.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec2.html</a>   |
| Unit-II  | 2D Transformations                | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec6.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec6.html</a>   |
|          | Composite Transformations         | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec7.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec7.html</a>   |
| Unit-III | Clipping                          | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec8.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec8.html</a>   |
|          | Polygon Clipping                  | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec9.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec9.html</a>   |
| Unit-IV  | Illumination Models               | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec17.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec17.html</a> |
|          | Shading Techniques                | <a href="https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec18.html">https://nptel.ac.in/noc/courses/noc19/SEM2/noc19cs34/lec18.html</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | LC-BCA-211B                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |              |
| Category                 | Discipline Specific Elective Courses                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |              |
| Course Title             | Computer Graphics Lab                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                 | T | P | Credits | Semester III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To develop a foundational understanding of 2D graphics concepts and algorithms such as line and circle drawing, transformations, and clipping techniques.</li><li>• To enable students to apply and implement computer graphics algorithms for visualizing geometric transformations, object rendering, and graphical manipulations using programming.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |              |
| End Semester Examination | 35Marks                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                                                                              | RBT Level        |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| CO1 | Apply basic computer graphics algorithms such as DDA, Bresenham's line and circle drawing to construct and render 2D primitives.                 | Level 3: Apply   |
| CO2 | Implement 2D geometric transformations such as translation, rotation, scaling, reflection, and shearing on graphical objects.                    | Level 4: Analyze |
| CO3 | Analyze and compare different line and polygon clipping algorithms, and implement solutions to clip graphics primitives within a defined window. | Level 5 Evaluate |
| CO4 | Evaluate the effect of various transformations and coloring techniques in rendering graphical scenes.                                            | Level 6 Create   |

#### List of Experiments:

| Exp. no. | Contents                                                                                                     |
|----------|--------------------------------------------------------------------------------------------------------------|
| 1.       | Implement a program to define and use basic graphics primitives such as points, lines, and polygons.         |
| 2.       | Implement a program to draw a line using the Digital Differential Analyzer (DDA) algorithm.                  |
| 3.       | Create a program to draw a line using Bresenham's line drawing algorithm.                                    |
| 4.       | Write a program to draw a circle using the Midpoint Circle algorithm.                                        |
| 5.       | Implement a program to draw a circle using Bresenham's circle drawing algorithm.                             |
| 6.       | Create a program to perform 2D transformations: translation, rotation, and scaling on a given set of points. |
| 7.       | Write a program to perform mirror reflection of a 2D shape across the x-axis and y-axis.                     |

|            |                                                                                                                                                |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>8.</b>  | Create a program to draw basic two-dimensional objects like rectangles, triangles, and polygons using inbuilt functions                        |
| <b>9.</b>  | Write a program to implement the Cohen-Sutherland line clipping algorithm to clip a line within a rectangular clipping window.                 |
| <b>10.</b> | Write a program to apply a shearing transformation to a 2D object (like a square or triangle) and display the original and transformed objects |
| <b>11.</b> | Write a program to apply various coloring techniques to 2D pictures..                                                                          |
| <b>12.</b> | Write a program to implement line clipping using the Cohen-Sutherland line clipping algorithm                                                  |

### Discipline Specific Elective Course (BCA- Data Science)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | DSE-BCA-DS-201B                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |              |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |              |
| Course Title             | Basics of Data Analytics using Spreadsheet                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                         | T | P | Credits | Semester-III |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 | 0 | 1       |              |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of data analytics, including types of data and analytical approaches.</li><li>• To understand the importance and applications of data analytics across various domains and industries.</li><li>• To understand data collection, preprocessing techniques, and ethical considerations in data analytics.</li></ul> |   |   |         |              |
| Assessment               | 05Marks                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |              |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Total                    | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                      | RBT Level          |
|------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | Define concepts of data, types, analytics processes, data handling methods, ethics, and industry applications.                           | Level-1 Remember   |
| <b>CO2</b> | Explain data types, analytics techniques, data preparation steps, ethical issues, and real-world applications across industries.         | Level-2 Understand |
| <b>CO3</b> | Apply data analytics methods including data collection, cleaning, transformation, and interpretation in practical scenarios.             | Level-3 Apply      |
| <b>CO4</b> | Analyze datasets and case studies to evaluate data types, preprocessing methods, ethical considerations, and industry-specific outcomes. | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

## Unit-I

### Introduction to Data Analytics

Understanding data and its types (structured, unstructured, semi-structured)-What is Data Analytics- Types of data Analytics

## Unit-II

### Importance and Applications

Importance of Data Analytics- Applications of Data Analytics.

## Unit-III

### Data- Ethics

Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation - Handling Missing Data and Outliers. - Ethical considerations in data analytics.

## Unit-IV

### Applications in Industry-Case Studies

Real-world Applications of Data Analytics- Industry-specific applications (finance, marketing, operations) - Case Study

**Note:** Case study is for discussion not to be considered for evaluation.

### Reference Books :

- "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018
- "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cengage learning asia pet. 2015
- "Mastering Excel" by WebTech Solutions, Khanna Publishing House, 2024.

### Video Links

| Topics                                                          | Links                                                                                     |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Data Analytics                                                  | <a href="https://nptel.ac.in/courses/106107220">https://nptel.ac.in/courses/106107220</a> |
| Importance of Data Analytics                                    | <a href="https://nptel.ac.in/courses/106101224">https://nptel.ac.in/courses/106101224</a> |
| Data Cleaning                                                   | <a href="https://nptel.ac.in/courses/110104513">https://nptel.ac.in/courses/110104513</a> |
| Industry-specific applications (finance, marketing, operations) | <a href="https://nptel.ac.in/courses/110103917">https://nptel.ac.in/courses/110103917</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |              |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | LC-BCA-DS-203B                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Course Title             | Basics of Data Analytics using Spreadsheet Lab                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To understand the fundamental features of Excel, including data entry, formatting, functions, and cell referencing.</li><li>• To understand data import, cleaning, transformation techniques, and basic statistical analysis using Excel tools.</li><li>• To understand data visualization, PivotTables, and dashboard creation techniques for effective data analysis and presentation.</li></ul> |   |   |         |              |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                              | RBT Level        |
|-----|--------------------------------------------------------------------------------------------------|------------------|
| CO1 | Apply Excel functions and formulas for data entry, calculation, and basic analysis.              | Level-3 Apply    |
| CO2 | Analyze datasets using data cleaning, transformation techniques, and statistical tools in Excel. | Level-4 Analyze  |
| CO3 | Evaluate data using visualization methods and advanced charting techniques to derive insights.   | Level-5 Evaluate |
| CO4 | Create interactive dashboards using PivotTables, Pivot Charts, and conditional formatting.       | Level-6 Create   |

**List of Experiments:**

| EXP. No. | Experiments                                                                          |
|----------|--------------------------------------------------------------------------------------|
| 1        | Getting started with Excel: Workbook, Worksheet, Cells, and Ranges                   |
| 2        | Data entry and basic formatting techniques                                           |
| 3        | Using basic arithmetic functions: SUM, AVERAGE, MIN, MAX, ROUND                      |
| 4        | Introduction to cell referencing: relative, absolute, and mixed                      |
| 5        | Importing data from various sources (CSV, text files, web data)                      |
| 6        | Data cleaning: removing duplicates, handling missing data, and standardizing formats |
| 7        | Data transformation: text-to-columns, data validation techniques                     |
| 8        | Using the "Find & Replace" and "Text Functions" (LEFT, RIGHT, MID,                   |
| 9        | Calculating measures of central tendency: mean, median, mode                         |
| 10       | Computing measures of dispersion: range, variance, standard deviation                |
| 11       | Creating and interpreting frequency distributions and histograms                     |
| 12       | Using Excel's "Data Analysis Toolpak" for basic statistical analysis                 |
| 13       | Using logical functions: IF                                                          |
| 14       | Lookup and reference functions: VLOOKUP                                              |

|    |                                                                                                                      |
|----|----------------------------------------------------------------------------------------------------------------------|
| 15 | Data aggregation techniques: SUMIFS                                                                                  |
| 16 | Text functions for data manipulation: TRIM                                                                           |
| 17 | Creating various chart types: bar, line, pie, scatter                                                                |
| 18 | Advanced charting techniques: combo charts, dual-axis charts                                                         |
| 19 | Data visualization best practices: choosing the right chart, formatting, and styling                                 |
| 20 | Creating and customizing PivotTables and Pivot Charts                                                                |
| 21 | Introduction to dashboards: concepts and components                                                                  |
| 22 | Using PivotTables and Pivot Charts for dashboard elements                                                            |
| 23 | Applying conditional formatting for dynamic visual cues 4. Creating interactive dashboards with slicers and timeline |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

## Discipline Specific Elective Course (BCA- AIML)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |          |                     |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|----------|---------------------|
| Course Code              | <b>DSE-BCA-AIML-201B</b>                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |          |                     |
| Category                 | <b>Discipline Specific Elective</b>                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |          |                     |
| Course Title             | <b>Feature Engineering</b>                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |          |                     |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                  | T | P | Credits  | <b>Semester-III</b> |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 0 | <b>1</b> |                     |
| Course Objectives        | The objectives of this course are to <ul style="list-style-type: none"><li>• To understand the fundamental concepts of data, features, and feature engineering in machine learning.</li><li>• To understand data preprocessing techniques including cleaning, transformation, encoding, and scaling methods.</li><li>• To understand feature engineering techniques such as feature selection, extraction, and dimensionality reduction.</li></ul> |   |   |          |                     |
| Assessment               | 05Marks                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |          |                     |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |          |                     |
| Total                    | 25Marks                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |          |                     |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |          |                     |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                          | RBT Level             |
|------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>CO1</b> | Define concepts of data, features, and feature engineering techniques including preprocessing and feature selection methods. | Level-1<br>Remember   |
| <b>CO2</b> | Explain types of features, preprocessing steps, and feature engineering techniques for numerical and categorical data.       | Level-2<br>Understand |
| <b>CO3</b> | Apply feature engineering techniques such as scaling, encoding, transformation, and feature extraction on datasets.          | Level-3 Apply         |
| <b>CO4</b> | Analyze datasets using feature selection and dimensionality reduction techniques such as filter methods and PCA.             | Level-4 Analyze       |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit- I

#### Introduction to Feature Engineering

Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio.

## **Unit- II**

### **Basic Feature Engineering**

Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation.

## **Unit -III**

### **Feature Engineering Techniques I**

Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding.

## **Unit- IV**

### **Feature Engineering Techniques II**

Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction: Introduction and application of Principal Components Analysis.

### **Suggested Readings:**

- M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024.
- Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc.
- Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13: 9780323917780.
- Reference Books:
  - Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
  - N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
  - M.C. Trivedi, Deep Learning and Neural Network\_MC Trivedi, Khanna Publishing House, 2024.
  - Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500.
  - Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.
  - Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047.
  - Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc.
  - Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating, engineering, and transforming features to build machine learning models. Packt Publishing, Limited.
  - Nielsen, Aileen. (2019). Practical time series analysis: Prediction with statistics and machine learning. O'Reilly Media.
  - Rajiv Chopra, Deep Learning, Khanna Publishing House, 2024.
  - Jeeva Jose, Machine Learning, Khanna Publishing House, 2024.
  - Chollet, François. (2017). Deep learning with Python. Manning Publications. ISBN 9781617294433.

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |              |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|--------------|
| Course Code              | LC-BCA-AIML-203B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |              |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |              |
| Course Title             | Feature Engineering Lab                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |              |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | T | P | Credits | Semester-III |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0 | 4 | 2       |              |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• Apply data preprocessing techniques such as handling missing values, cleaning invalid data, scaling numerical features, and encoding categorical variables.</li><li>• Analyze and explore datasets using visualization methods, correlation analysis, and time-series decomposition to understand data patterns and relationships.</li><li>• Develop and implement advanced data transformation methods including feature engineering, text processing, image augmentation, and dimensionality reduction.</li></ul> |   |   |         |              |
| Assessment               | 15Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |              |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |              |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                                                                                  | RBT Level        |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | <b>Apply</b> data preprocessing and feature engineering techniques including missing value handling, data cleaning, scaling, normalization, encoding, transformation, and text and image processing. | Level-3 Apply    |
| <b>CO2</b> | <b>Analyze</b> datasets using exploratory data analysis, correlation analysis, feature transformation, time series decomposition, and dimensionality reduction techniques.                           | Level-4 Analyze  |
| <b>CO3</b> | <b>Evaluate</b> feature engineering and data representation methods including binning, polynomial features, TF-IDF, Bag-of-Words, image augmentation, and PCA.                                       | Level-5 Evaluate |
| <b>CO4</b> | <b>Design</b> data preprocessing and feature engineering pipelines for structured, unstructured, image, and time-series data to improve model performance.                                           | Level-6 Create   |

**List of Experiments:**

| Exp No. | Contents                                                                                                                                                                             |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | Handle missing values in column(s) of a dataset. For example, fill missing values with the mean/median/mode of the columns such as 'Age', 'Height', 'Weight', 'Grade' for a dataset. |

|     |                                                                                                                                                                                                                     |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.  | Clean a dataset by identifying and removing invalid data entries. For example, a dataset having columns 'Name', 'Gender' and 'Age' where 'Name' contains 'invalid data'.                                            |
| 3.  | Scale numerical features using Min-Max normalization for a dataset with columns like 'Height', 'Weight'.                                                                                                            |
| 4.  | Perform exploratory data analysis and visualize data distributions using histograms and boxplots.                                                                                                                   |
| 5.  | Compute and visualize the correlation matrix of a dataset with 2 or more columns.                                                                                                                                   |
| 6.  | Bin numerical data into discrete intervals for a dataset with a column containing numerical values.                                                                                                                 |
| 7.  | Create polynomial and interaction features from numerical data in a dataset with two columns.                                                                                                                       |
| 8.  | Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.                                                                                                                  |
| 9.  | Perform one-hot encoding on categorical features in a dataset with column 'Category' containing categorical values. The distinct values in the Category feature are [Good, Better, Best] and Gender [Male, Female]. |
| 10. | Preprocess text data (tokenization) for a dataset with a column 'Text'.                                                                                                                                             |
| 11. | Preprocess text data (stemming) for a dataset with a column 'Text'.                                                                                                                                                 |
| 12. | Preprocess text data (lemmatization) for a dataset with a column 'Text'.                                                                                                                                            |
| 13. | Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.                                                                                                                            |
| 14. | Apply TF-IDF transformation to text data for a column 'Text'.                                                                                                                                                       |
| 15. | Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.                                                                                                                    |
| 16. | Perform image augmentation resizing for a set of images.                                                                                                                                                            |
| 17. | Perform image augmentation normalization for a set of images.                                                                                                                                                       |
| 18. | Perform image augmentation rotation for a set of images.                                                                                                                                                            |
| 19. | Perform image augmentation translation for a set of images.                                                                                                                                                         |
| 20. | Decompose a time series into trend, seasonal, and residual components for a dataset with a column 'TimeSeries'.                                                                                                     |
| 21. | Perform Principal Component Analysis (PCA) on a dataset and visualize the first two principal components.                                                                                                           |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

# **SEMESTER –IV**

**(Syllabi of Common Courses for all streams )**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | CC-BCA-202B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |             |
| Course Title             | Entrepreneurship and Startup Ecosystem                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | T | P | Credits | Semester-IV |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 | 0 | 2       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the concept of entrepreneurship, characteristics of entrepreneurs, and the role of family businesses in economic development.</li><li>• To evaluate business opportunities through idea generation, market assessment, and feasibility analysis.</li><li>• To develop knowledge of essential components required for starting and managing a new venture, including marketing, team building, funding, and legal aspects, along with the start-up ecosystem and funding sources in India.</li></ul> |   |   |         |             |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |             |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |             |
| Total                    | 50Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                            | <b>RBT Level</b>   |
|------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | <b>Recall</b> the concepts, characteristics, classifications of entrepreneurs, and features of family businesses.                     | Level-1 Remember   |
| <b>CO2</b> | <b>Explain</b> the process of identifying and evaluating business opportunities, including market potential and feasibility analysis. | Level-2 Understand |
| <b>CO3</b> | <b>Apply</b> the key building blocks required for starting ventures, including marketing, team building, funding, and legal aspects.  | Level-3 Apply      |
| <b>CO4</b> | <b>Analyze</b> the components of the start-up ecosystem, government schemes, and sources of venture funding in India.                 | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 1 mark each from all units and remaining 8 questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### **Unit -I**

**Introduction to Entrepreneurship & Family Business:** Definition and Concept of entrepreneurship, Entrepreneur Characteristics, Classification of Entrepreneurs, Role of Entrepreneurship in Economic Development –Start-ups, Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.

## Unit- II

**Evaluating Business opportunity:** Sources of business ideas and opportunity recognition, Guesstimating the market potential of a business idea, Feasibility analysis of the idea, Industry, competition and environment analysis.

## Unit- III

**Building Blocks of starting ventures:** Low cost Marketing using digital technologies, Team building from scratch, Venture Funding, Establishing the value-chain and managing operations, Legal aspects like IPR and Compliances 81.

## Unit- IV

**Start-up Ecosystem:** Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc. Know various govt. schemes like Start-up India, Digital India, MSME etc. Sources of Venture Funding available in India Source of Technology, Intellectual Property management.

### Suggested Readings:

- Startup India Learning Program by Start Up India available
- [www.startupindia.gov.in](http://www.startupindia.gov.in)
- Entrepreneurship, Rajeev Roy, Oxford University Press
- Entrepreneurship: Successfully Launching New Ventures by R. Duane Ireland Bruce R. Barringer, Pearson Publishing
- Family Business Management by Rajiv Agarwal, Sage Publishing
- Anish Tiwari (2003), “Mapping the Startup Ecosystem in India”, Economic & Political
- Ramachandran, K, Indian Family Businesses: Their survival beyond three generations, ISB Working Paper Series

### Useful Video links:

| Unit No. | Topics               | Links                                                                                     |
|----------|----------------------|-------------------------------------------------------------------------------------------|
| 1        | Entrepreneurship     | <a href="https://nptel.ac.in/courses/107101092">https://nptel.ac.in/courses/107101092</a> |
| 2        | Feasibility analysis | <a href="https://nptel.ac.in/courses/110105067">https://nptel.ac.in/courses/110105067</a> |
| 3        | Cost Marketing       | <a href="https://nptel.ac.in/courses/110105067">https://nptel.ac.in/courses/110105067</a> |
| 4        | Ecosystem            | <a href="https://nptel.ac.in/courses/105105826">https://nptel.ac.in/courses/105105826</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | CC-BCA-204B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Course Title             | Computer Networks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | T | P | Credits | Semester-IV |
|                          | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0 | 0 | 3       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of computer networks, network models, topologies, transmission modes, and networking devices.</li><li>• To understand data link layer functions, Ethernet operations, IP addressing, subnetting, ARP, VLANs, and network protocols.</li><li>• To understand routing techniques, transport and application layer protocols, network security, and emerging networking technologies.</li></ul> |   |   |         |             |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                               | RBT Level          |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | <b>Define</b> fundamentals of computer networks including models, topologies, transmission modes, and networking devices.                         | Level-1 Remember   |
| <b>CO2</b> | <b>Explain</b> data link layer functions, Ethernet, IP addressing, subnetting, ARP, and VLAN concepts.                                            | Level-2 Understand |
| <b>CO3</b> | <b>Apply</b> routing techniques, transport layer mechanisms, congestion control methods, and network security principles in networking scenarios. | Level-3 Apply      |
| <b>CO4</b> | <b>Analyze</b> application layer protocols, emerging networking technologies, and network management and performance techniques.                  | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

## Unit -I

### Introduction to Computer Networks

**Overview of Computer Networks:** Definition and Objectives, Applications and Examples Network Components and Architecture

**Network Models:** OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions

Comparison between OSI and TCP/IP Models

**Network Topologies:** Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology

**Data Transmission:** Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency

**Networking Devices:** Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.

## Unit -II

### Data Link Layer and Networking Protocols

**Data Link Layer Fundamentals:** Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms.

**Ethernet:** Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods

**Network Protocols:** Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation

**Address Resolution Protocol (ARP):** ARP Operation and Table, ARP Spoofing and Security Considerations

**Virtual LANs (VLANs):** Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases

## Unit- III

### Network Layer and Transport Layer

**Network Layer:** IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT)

**Transport Layer:** TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP

**Congestion Control Algorithms:** Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas.

**Quality of Service (QoS):** QoS Principles and Mechanisms, Differentiated Services (DiffServ) and Integrated Services (IntServ)

**Network Security Fundamentals:** Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption

## Unit -IV

### Application Layer and Emerging Technologies

**Application Layer Protocols:** HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution

**Network Applications:** Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming.

**Emerging Technologies:** Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking

**Network Management:** SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques.

**Future Trends in Networking:** 5G and Beyond, Network Automation and Artificial Intelligence in Networking.

**Suggested Readings:**

- Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
- James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.
- Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
- Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
- Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023.
- Mastering PC Hardware & Networking, Khanna Publishing House, 2024.

**Useful Video links:**

| Unit No. | Topics                                   | Links                                                                                     |
|----------|------------------------------------------|-------------------------------------------------------------------------------------------|
| 1        | <b>Introduction to Computer Networks</b> | <a href="https://nptel.ac.in/courses/106105183">https://nptel.ac.in/courses/106105183</a> |
| 2        | <b>Data Link Layer</b>                   | <a href="https://nptel.ac.in/courses/106105081">https://nptel.ac.in/courses/106105081</a> |
| 3        | <b>Congestion Control Algorithms</b>     | <a href="https://nptel.ac.in/courses/106105081">https://nptel.ac.in/courses/106105081</a> |
| 4        | <b>Emerging Technologies</b>             | <a href="https://nptel.ac.in/courses/106106243">https://nptel.ac.in/courses/106106243</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |             |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | LC-BCA-206B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |             |
| Course Title             | Computer Networks Lab                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | T | P | Credits | Semester-IV |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 0 | 4 | 2       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the basic concepts of computer networks, including network models, topologies, transmission modes, and networking devices.</li><li>• To understand data link layer functions, Ethernet, IP addressing, subnetting, ARP, VLANs, and network protocols.</li><li>• To understand network configuration, performance measurement, simulation tools, security mechanisms, and troubleshooting techniques.</li></ul> |   |   |         |             |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                                   | <b>RBT Level</b> |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | Apply basic network configurations, protocols, and services including IP settings, DNS resolution, and HTTP client-server applications.      | Level-3 Apply    |
| <b>CO2</b> | Analyze network performance, traffic behavior, and connectivity issues using tools such as ping, trace route, iperf, and Wireshark.          | Level-4 Analyze  |
| <b>CO3</b> | Evaluate network designs, VLAN configurations, routing setups, and security mechanisms in simulated environments.                            | Level-5 Evaluate |
| <b>CO4</b> | Create functional network solutions by designing topologies, configuring devices, deploying web servers, and implementing security features. | Level-6 Create   |

**List of Experiments:**

| <b>Experiment no.</b> | <b>Contents</b>                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.                    | <b>Configure Basic Network Settings:</b><br>a) IP Address Configuration<br>b) Subnet Mask and Gateway Settings                                            |
| 2.                    | <b>Implement Network Protocols:</b><br>a) Write a simple Python script to perform DNS resolution.<br>b) Implement a basic HTTP client-server application. |

|    |                                                                                                                                                                                                       |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3. | <b>Network Simulation:</b><br>a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.<br>b) Configure routers and switches in a simulated environment. |
| 4. | <b>Performance Measurement:</b><br>a) Measure network performance using tools like `ping`, `trace route`, and `iperf`.<br>b) Analyze network traffic using Wireshark.                                 |
| 5. | <b>Implement VLANs:</b><br>a) Configure VLANs on a switch and verify using simulation tools.                                                                                                          |
| 6. | <b>Set Up a Simple Web Server:</b><br>a) Deploy a basic web server and configure HTTP/HTTPS access.                                                                                                   |
| 7. | <b>Network Security Lab:</b><br>a) Implement basic firewall rules and VPN configurations.<br>b) Perform vulnerability scanning and analyze results.                                                   |
| 8. | <b>Network Troubleshooting:</b><br>a) Diagnose and resolve common network issues.<br>b) Use troubleshooting commands and techniques to fix connectivity problems.                                     |

#### Useful Video links:

| Experiment Name                                                                                                                                                                                       | Links                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| <b>Configure Basic Network Settings:</b><br>a) IP Address Configuration<br>b) Subnet Mask and Gateway Settings                                                                                        | <a href="https://nptel.ac.in/courses/106105183">https://nptel.ac.in/courses/106105183</a> |
| <b>Network Simulation:</b><br>a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.<br>b) Configure routers and switches in a simulated environment. | <a href="https://nptel.ac.in/courses/106105081">https://nptel.ac.in/courses/106105081</a> |
| <b>Network Security Lab:</b><br>a) Implement basic firewall rules and VPN configurations.<br>b) Perform vulnerability scanning and analyze results.                                                   | <a href="https://nptel.ac.in/courses/106105183">https://nptel.ac.in/courses/106105183</a> |
| <b>Set Up a Simple Web Server:</b><br>a) Deploy a basic web server and configure HTTP/HTTPS access.                                                                                                   | <a href="https://nptel.ac.in/courses/106105081">https://nptel.ac.in/courses/106105081</a> |

|                          |                                                                                                                                                                                                                                                                                                                        |   |   |         |             |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course code              | CC-BCA-208B                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                           |   |   |         |             |
| Course title             | Probability and Statistics                                                                                                                                                                                                                                                                                             |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                      | T | P | Credits | Semester-IV |
|                          | 3                                                                                                                                                                                                                                                                                                                      | 0 | 0 | 3       |             |
| Course Objectives:       | <div>The objectives of this course are<ul style="list-style-type: none"><li>To acquired knowledge about Probability, Random Variables, various Discrete, Continuous Probability distributions and their properties.</li><li>To learn various Statistical methods and techniques to study data samples.</li></ul></div> |   |   |         |             |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                               |   |   |         |             |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                               |   |   |         |             |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                               |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                               |   |   |         |             |

**Course Outcomes:** After studying this course, the students will be able to:

| CO  | Skill Demonstrated                                                                                                                                                               | Level              |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| CO1 | <b>Recall</b> fundamental concepts, definitions, and theorems related to probability, random variables, distributions, and statistical measures.                                 | Level 1:Remember   |
| CO2 | <b>Explain</b> the core concepts such as probability theorems, properties of distributions, and statistical methods for data analysis.                                           | Level 2:Understand |
| CO3 | <b>Apply</b> probability theory and statistical techniques to solve problems in real-world scenarios.                                                                            | Level 3:Apply      |
| CO4 | <b>Analyze</b> statistical data and probability distributions to identify relationships between variables, evaluate assumptions, and interpret the implications of test results. | Level 4:Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit- I

Basic concepts of Statistics, qualitative and quantitative data, classification of data, construction of frequency distribution, diagrammatic representation of data.

**Measures of Central Tendency:** Arithmetic mean, median and mode—their properties

**Measures of Dispersion:** Range, mean deviation, quartile deviation, variance and standard deviation.

### Unit- II

**Correlation:** Definition, scatter diagram, types of correlation, measures—Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient.

**Regression:** Linear regression-fitting by least square method and interpretation.

### Unit-III

**Concepts of probability:** Experiment and sample space, events and operations with events, Probability of an event, basic probability rules, applications of probability rules, conditional probability.

**Random Variables:** Discrete and continuous random variable, probability distribution of a random variable, probability mass function, probability density function, expectation and variance of a random variable.

**Standard Probability Distributions:** Binomial probability distribution, Poisson probability distribution, Normal probability distribution.

### Unit-IV

**Sampling Distribution:** Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample proportion.

**Statistical Inference:** Estimation and Hypothesis Testing (only concept).

**Hypothesis Testing for a Single Population:** Concept of a hypothesis testing, tests involving a population mean and population proportion (z test and t test).

Chi square test for independence of attributes and goodness of fit.

### Suggested Readings:

- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers .
- E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- N. P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications.
- P. Mukhopadhyay, Mathematical Statistics, Books and Allied Private Limited, Kolkata.
- S.C. Gupta, and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
- S. Ross, A First Course in Probability, Pearson Education .
- R. Jain and S.C. Aggarwal, Business Statistics, VK Global Publications Pvt. Ltd.

### Video URL links

| Unit No. | Topics                                      | Links                                                                                                                                                                                                                                                    |
|----------|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| UNIT-I   | Introduction to Probability and Statistics  | <a href="https://onlinecourses.nptel.ac.in/noc22_ma81/preview">https://onlinecourses.nptel.ac.in/noc22_ma81/preview</a> )<br><a href="https://archive.nptel.ac.in/courses/109/104/109104182/">https://archive.nptel.ac.in/courses/109/104/109104182/</a> |
| UNIT-II  | Correlation                                 | <a href="https://nptel.ac.in/courses/111106112">https://nptel.ac.in/courses/111106112</a>                                                                                                                                                                |
|          | Regression                                  | <a href="https://nptel.ac.in/courses/111105041">https://nptel.ac.in/courses/111105041</a>                                                                                                                                                                |
| UNIT-III | Concepts of probability                     | <a href="https://onlinecourses.nptel.ac.in/noc22_ma81/preview">https://onlinecourses.nptel.ac.in/noc22_ma81/preview</a>                                                                                                                                  |
|          | Random Variables                            | <a href="https://youtu.be/2CP3m3EgL1Q">https://youtu.be/2CP3m3EgL1Q</a>                                                                                                                                                                                  |
|          | Standard Probability Distributions          | <a href="https://youtu.be/60vHy21A4o4">https://youtu.be/60vHy21A4o4</a>                                                                                                                                                                                  |
| UNIT-IV  | Sampling Distribution                       | <a href="https://onlinecourses.nptel.ac.in/noc22_ma81/preview">https://onlinecourses.nptel.ac.in/noc22_ma81/preview</a>                                                                                                                                  |
|          | Hypothesis Testing for a Single Population. | <a href="https://youtu.be/14PQawp_rjk">https://youtu.be/14PQawp_rjk</a>                                                                                                                                                                                  |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | CC-BCA-210B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |             |
| Course Title             | Artificial Intelligence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | T | P | Credits | Semester-IV |
|                          | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0 | 0 | 3       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the concepts of data types, feature engineering, preprocessing, transformation, feature selection, and feature reduction.</li><li>• To understand feature engineering techniques including preprocessing methods, numerical and categorical data handling, and dimensionality reduction.</li><li>• To understand the application of feature engineering techniques for data preprocessing, feature transformation, encoding, selection, and reduction on datasets.</li></ul> |   |   |         |             |
| Assessment               | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| End Semester Examination | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Total                    | 75 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                                                                                                                | RBT Level          |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| CO1 | <b>Recall</b> the concepts of data types, feature engineering, preprocessing, transformation, feature selection, and feature reduction.                                            | Level-1 Remember   |
| CO2 | <b>Explain</b> feature engineering concepts including data types, preprocessing methods, numerical and categorical techniques, and feature selection and dimensionality reduction. | Level-2 Understand |
| CO3 | <b>Apply</b> feature engineering techniques for preprocessing, transformation, encoding, selection, and dimensionality reduction on datasets.                                      | Level-3 Apply      |
| CO4 | <b>Analyze</b> feature engineering methods including preprocessing, transformations, feature selection, and dimensionality reduction techniques.                                   | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 5 parts of 2 marks each from all units and remaining 8 questions of 10 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

## Unit- I

### Introduction to Feature Engineering

Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio

## Unit –II

### Basic Feature Engineering

Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization, and Transformation.

## Unit- III

### Feature Engineering Techniques I

Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding.

## Unit -IV

### Feature Engineering Techniques II

Feature extraction vs. feature selection, Steps in feature selection. Feature Selection Methods: Filter, Wrapper, and Hybrid. Feature Reduction: Introduction and application of Principal Components Analysis.

### Suggested Readings:

- M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024.
- Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc.
- Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13: 9780323917780.
- Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
- N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
- M.C. Trivedi, Deep Learning and Neural Network\_MC Trivedi, Khanna Publishing House, 2024.
- Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500.
- Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.
- Tan, Pang-Ning, Steinbach, Michael, Karpadne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047.
- Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc.
- Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating, engineering, and transforming features to build machine learning models. Packt Publishing, Limited.
- Nielsen, Aileen. (2019). Practical time series analysis: Prediction with statistics and machine learning. O'Reilly Media.
- Rajiv Chopra, Deep Learning, Khanna Publishing House, 2024.
- Jeeva Jose, Machine Learning, Khanna Publishing House, 2024.
- Chollet, François. (2017). Deep learning with Python. Manning Publications. ISBN 9781617294433.

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | LC-BCA-212B                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Category                 | Core Courses                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |             |
| Course Title             | Artificial Intelligence Lab                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | T | P | Credits | Semester-IV |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0 | 4 | 2       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of artificial intelligence, search algorithms, and problem-solving techniques.</li><li>• To understand constraint satisfaction, logical reasoning, and optimization methods used in AI systems.</li><li>• To understand natural language processing techniques, rule-based systems, and machine learning applications in AI.</li></ul> |   |   |         |             |
| Assessment               | 15Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |             |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |             |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                    | <b>RBT Level</b> |
|------------|-------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | Apply search algorithms, constraint satisfaction techniques, and optimization methods to solve basic AI problems.             | Level-3 Apply    |
| <b>CO2</b> | Analyze problem spaces using graph search, adversarial search, and logical reasoning techniques in artificial intelligence.   | Level-4 Analyze  |
| <b>CO3</b> | Evaluate AI models and approaches including rule-based systems, NLP techniques, and expert systems for decision-making tasks. | Level-5 Evaluate |
| <b>CO4</b> | Create AI applications such as chatbots, NLP pipelines, and CNN-based image classification systems using Python frameworks.   | Level-6 Create   |

**List of Experiment:-**

| <b>Experiment no.</b> | <b>Contents</b>                                                                                  |
|-----------------------|--------------------------------------------------------------------------------------------------|
| 1.                    | Demonstrate basic problem-solving using Breadth-First Search on a simple grid.                   |
| 2.                    | Implement Depth-First Search (DFS) on a small graph.                                             |
| 3.                    | Solve the Water Jug Problem using Breadth First Search (BFS).                                    |
| 4.                    | Implement a Hill Climbing search to find the peak in a numeric dataset.                          |
| 5.                    | Apply the A* Search algorithm to find the shortest path in a 4x4 grid.                           |
| 6.                    | Implement the Minimax search algorithm for 2-player games. You may use a game tree with 3 plies. |
| 7.                    | Solve the 4 – Queens Problem as a CSP backtracking problem.                                      |

|     |                                                                                                                                                                                                                                                |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.  | Use constraint propagation to solve a Magic Square puzzle.                                                                                                                                                                                     |
| 9.  | Apply optimization techniques to find the maximum value in a list.                                                                                                                                                                             |
| 10. | Represent and evaluate propositional logic expressions.                                                                                                                                                                                        |
| 11. | Implement a basic rule-based expert system for weather classification.                                                                                                                                                                         |
| 12. | Implement a basic AI agent with simple decision-making rules.                                                                                                                                                                                  |
| 13. | Implement a basic Rule-Based Chatbot.                                                                                                                                                                                                          |
| 14. | Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content.<br>a) Tokenizing<br>b) Filtering Stop Words<br>c) Stemming<br>d) Part of Speech tagging<br>e) Chunking<br>f) Named Entity Recognition (NER) |
| 15. | Perform Image classification for a given dataset using CNN. You may use Tensor flow /Keras.                                                                                                                                                    |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |             |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | SEC-BCA-202B                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
| Category                 | Skill Enhancement Courses                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Course Title             | Design Thinking and Innovation                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                               | T | P | Credits | Semester-IV |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                               | 1 | 0 | 2       |             |
| Course Objectives        | The objectives of this course are <ul style="list-style-type: none"><li>• To understand the concepts and process of design thinking and innovation.</li><li>• To develop creative problem-solving and customer-centric thinking skills.</li><li>• To familiarize students with ideation, prototyping, and implementation techniques.</li><li>• To develop skills in feedback analysis and innovative solution design.</li></ul> |   |   |         |             |
| Assessment               | 15Marks                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |             |
| Total                    | 50Marks                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
| Duration of Exam         | 03Hours                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |

**Course Outcomes: After successful completion of this course, the students will be able to**

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                                                          | <b>RBT Level</b>  |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| CO1        | <b>Define</b> the concepts, principles, stages, and significance of design thinking, innovation, and customer-centric problem-solving.                              | Level-1Remember   |
| CO2        | <b>Describe</b> empathy, ideation, prototyping, implementation, feedback mechanisms, and user-focused design approaches in the innovation process.                  | Level-2Understand |
| CO3        | <b>Apply</b> design thinking tools and techniques to identify problems, generate ideas, develop prototypes, and enhance customer experience in business situations. | Level-3Apply      |
| CO4        | <b>Analyze</b> customer needs, design challenges, feedback systems, and innovative solutions to improve product and service experiences.                            | Level-4Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 7 parts of 1 mark each from all units and remaining 8 questions of 7 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

## **UNIT – I**

**Basics of Design Thinking:** Concept of Innovation, Significance of Innovation in Business, Creative Thinking Process, Problem Solving Approaches, Design Thinking Approach, Objectives of Design Thinking, Design Thinking and Customer Centricity, Customer Challenges, Enhancing Customer Experience through Design Thinking, Parameters of Product Experience, Alignment of Customer

Expectations with Product, Global Success Stories of AirBnB, Apple, IDEO, Netflix, Stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement.

## UNIT – II

**Learning to Empathize and Define the Problem:** Importance of Empathy in Innovation Process, Development of Empathy using Design Tools, Observation and Assimilation of Information, Individual Differences and Uniqueness, Group Discussions and Activities for Understanding Individual Differences, Wicked Problems, Identification of Wicked Problems, Impact of Solutions to Wicked Problems.

## UNIT – III

**Ideate, Prototype and Implement:** Ideation Templates, Brainstorming, Systems Thinking, Concept of Brainstorming, Consensus Building on Wicked Problems, Mapping Customer Experience for Ideation, Methods of Prototyping, Rapid Prototyping, Implementation Process.

## UNIT – IV

Feedback, Re-Design & Re-Create: Feedback Loop, User Experience, Ergonomic Challenges, User-Focused Design, Final Concept Testing, Final Presentation, Innovative Design Concepts, Creative Problem-Solving Solutions.

### Suggested Readings:

- Developing Thinking Skills (The way to Success) by E Balaguruswamy , Khanna Book Publishing Company.
- Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation by Tim Brown, Harvard Business Review.
- 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing.
- Design Thinking by Nigel Cross, Bloomsbury.

### Useful Video Links:

| Unit No  | Topics                           | Links                                                                                                                                         |
|----------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Unit-I   | Introduction to Design Thinking  | <a href="https://viit.digimat.in/nptel/courses/video/109104109/L01.html">https://viit.digimat.in/nptel/courses/video/109104109/L01.html</a>   |
| Unit-II  | Design Thinking Phases – Empathy | <a href="http://www.digimat.in/nptel/courses/video/107107580/L02.html">http://www.digimat.in/nptel/courses/video/107107580/L02.html</a>       |
| Unit-III | Brain Storming                   | <a href="https://tkiet.digimat.in/nptel/courses/video/109107155/L33.html">https://tkiet.digimat.in/nptel/courses/video/109107155/L33.html</a> |
| Unit-IV  | Creative Problem Solving         | <a href="https://tkiet.digimat.in/nptel/courses/video/109107155/L15.html">https://tkiet.digimat.in/nptel/courses/video/109107155/L15.html</a> |

## Discipline Specific Elective Course ( BCA Only)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | DSE-BCA-202B                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Course Title             | Advance Database Systems                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                       | T | P | Credits | Semester-IV |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                       | 0 | 0 | 1       |             |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To understand the fundamentals of advanced database systems and EER modeling.</li><li>• To explore object-oriented and object-relational database concepts.</li><li>• To learn parallel and distributed database techniques.</li><li>• To study advanced database models and emerging database technologies.</li></ul> |   |   |         |             |
| Assessment               | 05 Marks                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Total                    | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Duration of Exam         | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                 | RBT Level          |
|------------|-----------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | Recall the fundamentals of advanced database systems, EER model, and database architecture.         | Level-1 Remember   |
| <b>CO2</b> | Explain object-oriented databases, object-relational databases, and information retrieval concepts. | Level-2 Understand |
| <b>CO3</b> | Apply the concepts of parallel and distributed databases for data management and query processing.  | Level-3 Apply      |
| <b>CO4</b> | Analyze client–server architecture, advanced database models, and emerging database technologies.   | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### UNIT-I

Introduction to Advanced Database Systems, applications, Enhanced Entity-Relationship (EER) Model, specialization, generalization, inheritance, and three-schema architecture with data independence.

### UNIT-II

Introduction to Object-Oriented Databases, object-oriented concepts, object identity, inheritance, object-relational databases, user-defined data types, and basics of information retrieval.

### UNIT-III

Fundamentals of Parallel and Distributed Databases, parallel database architectures, distributed database architecture, data fragmentation, replication, and basic query processing.

### UNIT-IV

Overview of Client–Server Architecture, active and temporal databases, spatial databases, multimedia databases, mobile databases, Geographic Information Systems (GIS), and introduction to XML and web databases.

#### Reference Books

1. Elmasri and Navathe: Fundamentals of Database Systems, Pearson Education.
2. Korth, Silberchatz, and Sudarshan: Database System Concepts, McGraw-Hill.
3. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, McGraw-Hill.
4. Peter Rob and Coronel: Database Systems – Design, Implementation, and Management, Thomson Learning.
5. C. J. Date: Introduction to Database Systems, Pearson Education.
6. Thomas Connolly and Carolyn Begg: Database Systems, Pearson Education.
7. W. H. Inmon: Building Data Warehouse, John Wiley & Sons.
8. S. Anahory and D. Murray: Data Warehousing, Pearson Education Asia.
9. Jiawei Han and Micheline Kamber: Data Mining – Concepts and Techniques, Harcourt India Pvt. Ltd. (Morgan Kaufmann Publishers).
10. Michall Corey, M. Abbey, I. Abramson, and Ben Taub: Oracle 8i Building Data Warehousing, Tata McGraw-Hill (TMH).
11. A. K. Pujari: Data Mining Techniques, University Press.

#### Video Links

| Topics                                 | Links                                                                                                           |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Advanced Database Models               | <a href="https://youtu.be/9MEVHebExhw?si=zDyMGsNQSVHfHSea">https://youtu.be/9MEVHebExhw?si=zDyMGsNQSVHfHSea</a> |
| Parallel and Distributed Databases     | <a href="https://youtu.be/QbyyBcVCfQc?si=_B0lBi6OTLXhj8Ug">https://youtu.be/QbyyBcVCfQc?si=_B0lBi6OTLXhj8Ug</a> |
| Client-Server Architectures            | <a href="https://youtu.be/q0JBXtZ3ixY?si=bRlwgzKuGTJEvVp3">https://youtu.be/q0JBXtZ3ixY?si=bRlwgzKuGTJEvVp3</a> |
| Enhanced Database Models               | <a href="https://youtu.be/PqPkYmRSQ_w?si=Rft7303Ntq83Ds25">https://youtu.be/PqPkYmRSQ_w?si=Rft7303Ntq83Ds25</a> |
| Emerging Database Technologies and XML | <a href="https://youtu.be/RcSa_Audhm0?si=CJm-FUOcGQyvjcB6">https://youtu.be/RcSa_Audhm0?si=CJm-FUOcGQyvjcB6</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |        |             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|--------|-------------|
| Course Code              | LC-BCA-214B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |        |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |        |             |
| Course Title             | Advance Database Systems Lab                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |        |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | T | P | Credit | Semester-IV |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 0 | 4 | 2      |             |
| Course Objectives        | <ul style="list-style-type: none"><li>• To study the evolution of database systems and their role in handling complex and large-scale data applications.</li><li>• To understand the design principles and implementation issues of object-oriented, object-relational, parallel, and distributed databases.</li><li>• To examine advanced database mechanisms for data storage, retrieval, concurrency control, and recovery.</li><li>• To explore modern trends in database technology, including XML, GIS, mobile databases, multimedia databases.</li></ul> |   |   |        |             |
| Assessment               | 15 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |        |             |
| End Semester Examination | 35Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |        |             |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |        |             |
| Duration of Exam         | 3 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |        |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                   | RBT Level        |
|------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | Apply advanced database models, EER concepts, object-oriented and object-relational database techniques to design database solutions. | Level-3 Apply    |
| <b>CO2</b> | Analyze the architectures and operations of parallel, distributed, and client-server database systems.                                | Level-4 Analyze  |
| <b>CO3</b> | Evaluate advanced database technologies, including active, temporal, spatial, deductive, and distributed database systems.            | Level-5 Evaluate |
| <b>CO4</b> | Create database solutions using emerging technologies such as XML, web databases, mobile databases, and GIS.                          | Level-6 Create   |

**List of Experiment:-**

| EXP No. | EXPERIMENTS                                                                            |
|---------|----------------------------------------------------------------------------------------|
| 1       | Create tables for Student, Course, and Enrollment and define primary and foreign keys. |
| 2       | Demonstrate Generalization and Specialization using Employee and Manager tables.       |
| 3       | Create SQL queries to illustrate Superclass and Subclass relationships.                |
| 4       | Create a simple object type (Student_Type) and insert records.                         |
| 5       | Create and manipulate nested tables and collections.                                   |
| 6       | Implement vertical fragmentation in a distributed database.                            |
| 7       | Implement horizontal fragmentation in a distributed database.                          |
| 8       | Write basic queries on object tables using OQL/SQL.                                    |
| 9       | Create indexes and compare query execution time.                                       |
| 10      | Demonstrate object views in an ORDBMS.                                                 |
| 11      | Create a database trigger for automatic record updates.                                |
| 12      | Create and query a simple XML document using XPath.                                    |

|    |                                                                          |
|----|--------------------------------------------------------------------------|
| 13 | Design a basic multimedia database table for storing image information.  |
| 14 | Develop a simple client-server database application for student records. |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

## Discipline Specific Elective Course (BCA- Data Science)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | DSE-BCA-DS-202B                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Course Title             | Data Visualization                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | T | P | Credits | Semester-IV |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0 | 0 | 1       |             |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To understand the fundamental concepts of data visualization, including types of data, processes, and challenges.</li><li>• To understand various visualization tools, storytelling techniques, and their role in effective communication.</li><li>• To understand principles of designing effective visualizations, including color usage, dashboard design, and data modeling.</li></ul> |   |   |         |             |
| Assessment               | 05Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |             |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
| Total                    | 25 marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs        | Skills Demonstrated                                                                                                                       | RBT Level          |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>CO1</b> | Define concepts of data visualization, types of data, visualization tools, storytelling principles, and design elements.                  | Level-1 Remember   |
| <b>CO2</b> | Explain the data visualization process, tool functionalities, storytelling techniques, and design principles for effective communication. | Level-2 Understand |
| <b>CO3</b> | Apply visualization tools, data storytelling methods, and design principles to create meaningful visual representations.                  | Level-3 Apply      |
| <b>CO4</b> | Analyze visualizations, dashboards, and data models to assess effectiveness, limitations, and decision-making impact.                     | Level-4 Analyze    |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### UNIT- I

#### Introduction to Data Visualization

Definition and importance of data visualization, Role of data visualization in decision making, Types of data (numerical, categorical, temporal, geographical)-Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization.

## **UNIT – II**

### **Visualization tools**

Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools.

## **UNIT – III**

### **Data Storytelling**

Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity.

## **UNIT – IV**

### **Designing Effective Visualizations**

Principles of Good Visualization Design - Understanding and Using Color in Visualizations – Importance of Data Modelling in Visualization.

### **Reference Books :**

- "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.
- "The Visual Display of Quantitative Information" by Edward Tufte, Graphics Press USA; 2nd edition, 2001.
- "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.
- "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.
- "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |   |         |             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | LC-BCA-DS-204B                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |   |         |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |             |
| Course Title             | Data Visualization Using Power BI LAB                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | T | P | Credits | Semester-IV |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0 | 4 | 2       |             |
| Course Objectives        | <p>The objectives of this course are</p> <ul style="list-style-type: none"><li>• To understand the Power BI environment, including its interface, data sources, and report creation process.</li><li>• To understand data preparation techniques such as importing, cleaning, transforming, and managing relationships using Power Query Editor.</li><li>• To understand data visualization, report publishing, sharing, and dashboard management using Power BI Service.</li></ul> |   |   |         |             |
| Assessment               | 15Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |   |         |             |
| End Semester Examination | 35 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                            | <b>RBT Level</b> |
|------------|-----------------------------------------------------------------------------------------------------------------------|------------------|
| <b>CO1</b> | Apply Power BI tools and features to import data, perform transformations, and create basic reports.                  | Level-3 Apply    |
| <b>CO2</b> | Analyze datasets by establishing relationships, resolving inconsistencies, and using calculated columns and measures. | Level-4 Analyze  |
| <b>CO3</b> | Evaluate visualizations and reports for effectiveness, accuracy, and suitability for decision-making.                 | Level-5 Evaluate |
| <b>CO4</b> | Create interactive dashboards and reports using Power BI and deploy them through the Power BI Service                 | Level-6 Create   |

**List of Experiments:**

| <b>EXP. No.</b> | <b>Experiments</b>                                                           |
|-----------------|------------------------------------------------------------------------------|
| 1               | Installation and interface overview                                          |
| 2               | Exploring the Power BI workspace: Ribbon, panes, and canvas.                 |
| 3               | Importing data from Excel and CSV files.                                     |
| 4               | Introduction to multiple data sources                                        |
| 5               | Basic report creation: Adding visuals and saving a report.                   |
| 6               | Using Power Query Editor                                                     |
| 7               | Cleaning data: Removing duplicates, handling missing values.                 |
| 8               | Transforming data: Splitting columns, changing data types, renaming columns. |
| 9               | Merging and appending queries.                                               |

|    |                                                                    |
|----|--------------------------------------------------------------------|
| 10 | Creating custom columns and calculated columns                     |
| 11 | Creating relationships between tables                              |
| 12 | Identifying and resolving data inconsistencies                     |
| 13 | Creating calculated columns and measures                           |
| 14 | Creating various chart types (bar, column, line, pie, area, etc.,) |
| 15 | Formatting and customizing visualizations                          |
| 16 | Publishing a report to Power BI Service.                           |
| 17 | Sharing reports and dashboards with team members.                  |

**At least 12 experiments to be studied/performed from the above list and other experiments can be studied/performed depending upon the scope of course as decided by the department.**

## Discipline Specific Elective Course (BCA- AIML)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | DSE-BCA-AIML-202B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |   |         |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |   |         |             |
| Course Title             | Introduction to Machine Learning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | T | P | Credits | Semester-IV |
|                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0 | 0 | 1       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>To understand the fundamental concepts of machine learning, including types of learning, datasets, and basic problem formulations.</li><li>To understand machine learning processes such as model training, validation, testing, and performance evaluation metrics.</li><li>To understand machine learning techniques including regression, classification, clustering, neural networks, and real-world applications.</li></ul> |   |   |         |             |
| Assessment               | 05Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| End Semester Examination | 20 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |             |
| Total                    | 25 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| COs | Skills Demonstrated                                                                                                            | RBT Level             |
|-----|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| CO1 | <b>Recall</b> machine learning concepts including types, learning framework, evaluation metrics, algorithms, and applications. | Level-1<br>Remember   |
| CO2 | <b>Explain</b> supervised, unsupervised, and reinforcement learning, model training, evaluation, and key algorithms.           | Level-2<br>Understand |
| CO3 | <b>Apply</b> machine learning algorithms for regression, classification, clustering, neural networks, and evaluation.          | Level-3 Apply         |
| CO4 | <b>Analyze</b> machine learning models using performance metrics, learning methods, clustering validation, and applications.   | Level-4 Analyze       |

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 4 parts of 1 mark each from all units and remaining 8 questions of 4 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

### Unit –I

#### **Introduction to Machine Learning**

Introduction: Definition, History and Application of Machine Learning, Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. Supervised Learning Tasks: Regression vs. Classification.

## Unit -II

### Learning Framework and Evaluation Parameters

Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation

Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.

## Unit -III

### Supervised Learning and Unsupervised Learning I

Regression: Linear and non-linear Regression, Logistic Regression. Classification: Naïve Bayes, K-Nearest Neighbors, Decision Trees. Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron.

## Unit -IV

### Supervised Learning and Unsupervised Learning II

Introduction to Support Vector Machine for linearly separable data. Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. ML Applications: Ethical Considerations in Machine Learning, Case study and Real-world Applications.

### Suggested Readings:

- Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
- Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
- Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
- Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780
- Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.
- Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification ( 2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
- Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.
- Chollet, F. (2018). Deep Learning with Python. Manning Publications.
- Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
- Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems\* (1st ed.). O'Reilly Media.

### Useful Video links:

| Unit No. | Topics                           | Links                                                                                     |
|----------|----------------------------------|-------------------------------------------------------------------------------------------|
| 1        | Introduction to Machine Learning | <a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a> |
| 2        | Learning Framework               | <a href="https://nptel.ac.in/courses/106106139">https://nptel.ac.in/courses/106106139</a> |
| 3        | Supervised Learning              | <a href="https://nptel.ac.in/courses/106106139">https://nptel.ac.in/courses/106106139</a> |
| 4        | K-Means                          | <a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |   |         |             |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---------|-------------|
| Course Code              | LC-BCA-AIML-204B                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |   |         |             |
| Category                 | Discipline Specific Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |   |         |             |
| Course Title             | Introduction to Machine Learning Lab                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |   |         |             |
| Scheme and Credits       | L                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | T | P | Credits | Semester-IV |
|                          | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0 | 4 | 2       |             |
| Course Objectives        | <p>The objectives of this course are to</p> <ul style="list-style-type: none"><li>• To understand machine learning concepts including types of learning, datasets, and basic problem formulation.</li><li>• To understand model building processes such as training, testing, validation, and performance evaluation techniques.</li><li>• To understand machine learning algorithms including regression, classification, clustering, neural networks, and ensemble methods.</li></ul> |   |   |         |             |
| Assessment               | 15Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |             |
| End Semester Examination | 35Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |   |         |             |
| Total                    | 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |
| Duration of Exam         | 03 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |   |   |         |             |

**Course Outcomes:** After successful completion of this course, the students will be able to

| <b>COs</b> | <b>Skills Demonstrated</b>                                                                                                                                       | <b>RBT Level</b>    |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>CO1</b> | <b>Apply</b> machine learning algorithms including regression, classification, clustering, PCA, neural networks, and boosting on datasets.                       | Level-3 Apply       |
| <b>CO2</b> | <b>Analyze</b> performance of models such as regression, classification, SVM, clustering, PCA, and ensemble methods using evaluation metrics and visualizations. | Level-4<br>Analyze  |
| <b>CO3</b> | <b>Evaluate</b> machine learning techniques including decision trees, Naive Bayes, random forest, clustering, PCA, and perceptron models.                        | Level-5<br>Evaluate |
| <b>CO4</b> | <b>Design</b> machine learning solutions using appropriate supervised, unsupervised, neural network, and ensemble methods for real-world problems.               | Level-6<br>Create   |

**List of Experiments:**

| <b>Exp No.</b> | <b>Contents</b>                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------|
| 1.             | Implement linear regression on a dataset and visualize the regression line.                        |
| 2.             | Implement logistic regression on a binary classification dataset and plot the decision boundary.   |
| 3.             | Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset. |
| 4.             | Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.           |
| 5.             | Build and evaluate a random forest classifier using a numerical dataset.                           |

|     |                                                                                                                                                                                 |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.  | Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary.                                                              |
| 7.  | Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.                                                                                        |
| 8.  | Implement hierarchical clustering on a dataset and plot the dendrogram.                                                                                                         |
| 9.  | Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.                                                                                               |
| 10. | Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.                          |
| 11. | Build a single layer perceptron model to classify AND, OR, and XOR problems (may use Tensor Flow/Keras) and visualize their decision boundaries. Also evaluate its performance. |
| 12. | Demonstrate the concept of boosting using the AdaBoost algorithm.                                                                                                               |

#### Useful Video links:

| Experiment name                                                                                                                                        | Links                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| Implement hierarchical clustering on a dataset and plot the dendrogram.                                                                                | <a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a> |
| Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.                                                               | <a href="https://nptel.ac.in/courses/106106139">https://nptel.ac.in/courses/106106139</a> |
| Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.                                                               | <a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a> |
| Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction. | <a href="https://nptel.ac.in/courses/106105152">https://nptel.ac.in/courses/106105152</a> |