

**Faculty of Science and Technology**  
**Savitribai Phule Pune University, Pune**



**NEP – 2020 Complaint Curriculum**

**Draft copy of Syllabus  
for**

**S.Y. Bachelor of Computer Applications (BCA)  
(2024 Pattern)**

**(with effect from A. Y. 2025-26)**

## Preamble

Dear Students, teachers and all stakeholders

The field of computing is rapidly expanding and changing, especially, since the last decade with continuous emergence of new disruptive technologies such as artificial intelligence, data science, cyber security, Internet of things, robotics and so on.

21<sup>st</sup> Century has witnessed rapid technological developments in every sector including the field of Computing. Moreover, it has created new job roles and massive job opportunities for budding graduates. Premium Institutes, public and private Universities, autonomous and affiliated colleges in India have always played a crucial role in producing human resources with required skill sets by capturing and monitoring these developments and offered various UG and PG programmes.

The Savitribai Phule Pune University, Pune has made its significant contribution by offering degree programmes as per the trends from time to time. In the year 1989, it started offering a degree programme Bachelor of Computer Science (BCS), now called B. Sc. (Computer Science) and was its unique offering in the state of Maharashtra. Later the University offered undergraduate and graduate programmes such as Master of Computer Management (MCM), B. Sc. (Computer Applications) and Bachelor of Computer Applications (BCA), Master of Computer Applications (MCA), M. Sc (Computer Science), M. Sc. (Computer Applications) etc.

The Savitribai Phule Pune University, Pune has taken a leading role in design and implementation of Programmes as per the guidelines and recommendations of National Education Policy (NEP) 2020. The university decided to offer UG and PG programmes with features recommended by NEP-2020 such as Multiple-entry/exit, inter and multi-disciplinary education, focus on skilling, on-job training/field projects, research, incorporation of Indian Knowledge System etc. for the holistic development of students.

The university has adopted the guidelines provided by the state Sukanu Samittee and prepared the credit structure for this UG programmes. The detailed draft for FY BCA was implemented from June 2024. This document provides detailed draft for SY BCA which will be implemented from June 2025.

The Ad-hoc Board of Studies in Computer Applications has prepared a structure for BCA with following features

- The structure of the course is designed as per National Education Policy (NEP) 2020 and is in line with university guidelines.
- The total credits offered for the three years with six semesters are 132 credits with 22 credits assigned for each of the six semesters. Candidate has an option to continue with fourth year either for Hon. with research or Hon. degree, each with 176 credits
- The programme has Multiple Entry/exit feature: A candidate may exit the programme after first, second, third or fourth year and shall be awarded with UG Certification, UG Diploma, Degree and Hon. Degree with Research / Hon. Degree respectively
- Various types of courses include – Major Core (MJ), Mandatory Elective (ME), Open Electives (OE), Minor (MN), Ability Enhancement (AEC), Value education (VEC), Vocational Skill (VSC), Skill enhancement (SEC), Indian Knowledge System (IKS), Co-curricular (CC) courses as well as courses on On-job Training (OJT), Field Project (FP), Community Engagement Programmes (CEP), Research Methodology (RM) and Research Project (RP).

I am thankful to Hon. Vice-Chancellor Prof. Dr. S W. Gosavi, Hon. Pro-Vice Chancellor Prof. Dr. Parag Kalkar, Hon. Dean of FoS&T, Prof. Dr. P D Patil for their guidance. I am thankful to all board members Dr. A B Nimbalkar, Dr. Razak Sayyad, Prof. Dr. R M Sonar and Prof. Dr. Sachin A. Kadam and all members of previous BoS for their valuable inputs as well as the teachers from affiliated colleges for their active participation in preparing the draft syllabus for SY BCA.

**Prof. Dr. S. S. Sane**

**Chairman,**

**Ad-hoc Board of Studies in Computer Applications**

**Faculty of Science and Technology, SPPU, Pune**

# Programme Outcomes

After successful completion of the Programme, the students shall be able to

- PO 01: Demonstrate understanding of fundamental concepts in the field of Computing
- PO 02: Design and develop computer-based applications.
- PO 03: Analyze existing research reported in the literature
- PO 04: Propose alternate solutions by undertaking research work.
- PO 05: Create efficient, reliable, readable and maintainable code.
- PO 06: Demonstrate a deeper understanding of the chosen domain.
- PO 07: Select appropriate method/algorithm to solve the given problem
- PO 08: Explain complex technical concepts clearly and effectively, both in written and oral forms.
- PO 09: Demonstrate ability to collaborate effectively with team members, understand different perspectives, and contribute productively to become successful professional.
- PO 10: Demonstrate ability to work with integrity and a sense of social responsibility.
- PO 11: Demonstrate self and life-long learning skills
- PO 12: Solve computational problems innovatively
- PO 13: Apply knowledge gained and critical thinking to develop real-world applications.

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**Structure of SY Bachelor of Computer Applications**  
**Level 5.0 Semester - III**

| Course Code  | Course Type | Course Name                           | Teaching Scheme Hrs/Week |           |           | Examination Scheme and Marks |            |            | Credits   |           |           |           |
|--------------|-------------|---------------------------------------|--------------------------|-----------|-----------|------------------------------|------------|------------|-----------|-----------|-----------|-----------|
|              |             |                                       | TH                       | TU        | PR        | CE                           | EE         | Total      | TH        | TU        | PR        | Total     |
| CA-201-MJ    | MJ          | Data Structures                       | 04                       | --        | --        | 30                           | 70         | <b>100</b> | 04        | --        | --        | <b>04</b> |
| CA-202-MJP   |             | Lab course on CA-201 -MJ              | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
| CA-221 -VSC  | VSC         | C++ Programming                       | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
| CA-231-FP    | FP          | Field Work                            | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
|              |             |                                       |                          |           |           |                              |            |            |           |           |           |           |
| ELS-241-MN   | MN          | Data Communications                   | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
| ELS-242-MNP  |             | Lab Course on CA - 241 –MN            | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
|              | GE/OE       | Course from University Basket         | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
| CA-200-IKS   | IKS         | Indian Knowledge System for Computing | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
|              | AEC         | Course from University Basket         | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
|              | CC          | Course from University Basket         | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
| <b>Total</b> |             |                                       | <b>14</b>                | <b>00</b> | <b>16</b> | <b>165</b>                   | <b>385</b> | <b>550</b> | <b>14</b> | <b>00</b> | <b>08</b> | <b>22</b> |

**Structure of SY Bachelor of Computer Applications**  
**Level 5.0 (SY) Semester – IV**

| Course Code   | Course Type | Course Name                   | Teaching Scheme Hrs/Week |           |           | Examination Scheme and Marks |            |            | Credits   |           |           |           |
|---------------|-------------|-------------------------------|--------------------------|-----------|-----------|------------------------------|------------|------------|-----------|-----------|-----------|-----------|
|               |             |                               | TH                       | TU        | PR        | CE                           | EE         | Total      | TH        | TU        | PR        | Total     |
| CA-251-MJ     | MJ          | Database Management Systems   | 04                       | --        | --        | 30                           | 70         | <b>100</b> | 04        | --        | --        | <b>04</b> |
| CA-252-MJP    |             | Lab course on CA-251 –MJ      | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
| CA-271-VSC    | VSC         | Python Programming            | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
| CA-281 CEP    | CEP         | Community Services            | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
|               |             |                               |                          |           |           |                              |            |            |           |           |           |           |
| ELS-291 - MN  | MN          | Communication Networks        | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
| ELS-292 - MNP |             | Lab course on CA -291 –MN     | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
|               | GE/OE       | Course from University Basket | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
| SEC-251-CA    | SEC         | Spreadsheet Applications      | --                       | --        | 04        | 15                           | 35         | <b>50</b>  | --        | --        | 02        | <b>02</b> |
|               | AEC         | Course from University Basket | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
|               | CC          | Course from University Basket | 02                       | --        | --        | 15                           | 35         | <b>50</b>  | 02        | --        | --        | <b>02</b> |
| <b>Total</b>  |             |                               | <b>10</b>                | <b>00</b> | <b>24</b> | <b>165</b>                   | <b>385</b> | <b>550</b> | <b>10</b> | <b>00</b> | <b>12</b> | <b>22</b> |

**Exit option:** Award of **UG Diploma** in Bachelor of Computer Applications (BCA) with **88** credits and an **additional 4** credits (for **either** a course by Microsoft/CCNA/Salesforce/Google/AWS/Oracle/RedHat etc. **or** Swayam/ NPTEL/MKCL MOOC course equivalent to core NSQF course **or** an internship) **or else** Continue with Major and Minor

# Detailed Drafts

For

## Level 5.0 (SY)

  

# SEMESTER III

**Savitribai Phule Pune University**  
**Second Year Bachelor of Computer Applications**  
**CA – 201 - MJ: Data Structures**

**Teaching Scheme:**  
**Theory: 04 Hrs./Week**

**Credits**  
**04**

**Examination Scheme:**  
**Continuous Evaluation: 30 Marks**  
**End-Semester: 70 Marks**

**Course Objectives:**

1. To study various data structures
2. To learn analysis of algorithms
3. To understand real-world applications of data structures.

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

**CO1:** Define various data structures and notations for algorithm analysis

**CO2:** Design algorithms using suitable data structure(s)

**CO3:** Compare various representations of a stack, queue, tree and graph

**CO4:** List real world applications of stacks, queues, trees and graphs

**CO5:** Apply appropriate data structure(s) to solve a given problem

**CO6:** Evaluate the time and space complexity of the given algorithm/program

**Course Contents**

| <b>Unit I</b>   | <b>Introduction to Data Structure</b>   | <b>10 Hrs.</b> |
|-----------------|---|----------------|
| 1.1             | Introduction, Basic concepts, Data types and data objects.  |                |
| 1.2             | Abstract Data Types (ADT)   |                |
| 1.3             | Types of Data Structures: Linear and non -linear  |                |
| 1.4             | Algorithm analysis: Frequency counts, Space and Time complexity, Asymptotic notation: Big O, Omega ( $\Omega$ ) (With examples) |                |
| <b>Unit II</b>  | <b>Arrays</b>   | <b>10 Hrs.</b> |
| 2.1             | Introduction  |                |
| 2.2             | Matrix representation using arrays: Row and column major, operations on matrices, Sparse Matrix                                 |                |
| 2.3             | Sorting techniques with time complexity: Bubble sort, Insertion sort, Merge sort, Quick sort                                    |                |
| 2.4             | Searching techniques with time Complexity: Linear search and Binary search  |                |
| <b>Unit III</b> | <b>Linked Lists</b>   | <b>10 Hrs.</b> |
| 3.1             | Introduction  |                |
| 3.2             | Representation  |                |
| 3.3             | Types of linked lists: Singly, Doubly, Circular (Singly, Doubly)  |                |
| 3.4             | Operations on link list: Create, Display, Insert, Delete, Reverse, Search, Sort,  |                |



|                |   |                |
|----------------|---|----------------|
| 3.5            | Concatenation, Merge<br>Real world applications of Link list : Polynomial Representation, Addition of two polynomials |                |
| <b>Unit IV</b> | <b>Stacks and Queues</b>  | <b>10 Hrs.</b> |
| 4.1            | Introduction  |                |
| 4.2            | Representation of Stack: Using arrays and Linked Lists  |                |
| 4.3            | Operations on stack: push, pop  |                |
| 4.4            | Applications of Stack: Recursion, Expressions: Infix to postfix, postfix to infix                                     |                |
| 4.5            | Representation of Queues: Static (Array) and Dynamic (Linked List)  |                |
| 4.6            | Operations on queue: insert, delete   |                |
| 4.7            | Types of queues: Circular queue and Priority queue  |                |
| 4.8            | Real world Applications of queue (Implementation not expected)  |                |

|                |  |                |
|----------------|--|----------------|
| <b>Unit V</b>  | <b>Trees</b>   | <b>10 Hrs.</b> |
| 5.1            | Introduction and terminologies   |                |
| 5.2            | Types of Binary Trees -Rooted Binary Tree, Full Binary Tree, Complete Binary Tree and Skewed Binary Tree, Expression Tree  |                |
| 5.3            | Representation of Trees using arrays and linked lists, traversals (In-order, pre-order, post-order) and operations (Create, Insert, delete, modify, counting nodes etc.) |                |
| 5.5            | Applications of Binary trees – Expression conversions and evaluation   |                |
| 5.6            | Binary Search Tree (BST): Introduction and Definition, operations on BST (Create, insert node, delete node, search node) and applications                                |                |
|                | 5.5.2 AVL Tree: Concept, Rotation (LL, LR, RL, RR) with Examples   |                |
|                | 5.5.3 Heap Sort Technique with Examples (Implementation not expected)  |                |
| <b>Unit VI</b> | <b>Graphs</b>  | <b>10 Hrs.</b> |

- |       |                                      |
|-------|--------------------------------------|
| 6.1   | Introduction and Graph terminologies |
| 6.2   | Representation of a Graph -          |
| 6.2.1 | Adjacency matrix                     |
| 6.2.2 | Adjacency list                       |
| 6.2.3 | Adjacency multi-list                 |
| 6.3   | Graph Traversals -                   |
| 6.3.1 | DFS (Depth First Search)             |
| 6.3.2 | BFS (Breadth First Search)           |
| 6.4   | Applications of graphs -             |
| 6.4.1 | Topological sort                     |
| 6.5   | Minimal Spanning Trees -             |
| 6.5.1 | Prim's Algorithm                     |
| 6.5.2 | Kruskal's Algorithm                  |

## Books

1. Horowitz, Ellis and Sahani Sartaj, "Fundamentals of Data Structures", 1<sup>st</sup> Edition, Galgotia, 1984
2. Kamthane, Ashok N., "Introduction to Data Structures using C", 1<sup>st</sup> Edition, Pearson, 2004
3. Bandopadhyaya, S. K. and Dey, K. S. "Data Structures using C", 1<sup>st</sup> Edition, Pearson, 2004
4. Srivastava, S. K. and Srivastava, D., "Data Structures using C", 1<sup>st</sup> Edition, BPB Publication, 2004
5. Gilberg, Richard F. and Forouzan, Behrouz A., "Data Structures: A Pseudocode approach with C", 2<sup>nd</sup> Edition, Cengage Learning, 2007
6. Steven S. S., "The Algorithm Design Manual", 2<sup>nd</sup> Edition, Springer, 2008

**Savitribai Phule Pune University**  
**Second Year Bachelor of Computer Applications**  
**CA - 202 - MJP: Lab course on CA – 201 - MJ**

|  |                             |   |
|--|-----------------------------|---|
| <b>Teaching Scheme:</b><br><b>Practical: 04 Hrs./Week/ Batch</b> | <b>Credits</b><br><b>02</b> | <b>Examination Scheme:</b><br><b>Continuous Evaluation: 15 Marks</b><br><b>End-Semester: 35 Marks</b> |
|--|-----------------------------|---|

**Course Objectives:**

1. To understand algorithms and analysis of algorithms
2. To learn static and dynamic data structures.

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

**CO1:** Apply appropriate data structures to solve the given problem

**CO2:** Design an efficient algorithm for the given problem and implement

**CO3:** Determine the time and space complexity of a given algorithm

**Guidelines for Instructor's Manual**

The instructor shall prepare instructor's manual consisting of university syllabus, conduction and Assessment guidelines.

**Guidelines for Student Journal**

The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).

**Guidelines for Assessment**

The instructor shall carry out internal evaluation of laboratory assignments of 15 marks on a continuous basis throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc.

A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during practical examination to judge understanding of concepts by the students.

| Assignment Nos | List of Assignments   | Number of Hrs. |
|----------------|---|----------------|
| 1              | Non-Recursive Sorting Techniques <ul style="list-style-type: none"> <li>Bubble Sort</li> <li>Insertion Sort</li> </ul>  | 4              |
| 2              | Recursive Sorting Techniques <ul style="list-style-type: none"> <li>Quick Sort</li> <li>Merge Sort</li> </ul>   | 6              |
| 3              | Searching Techniques <ul style="list-style-type: none"> <li>Linear search</li> <li>Binary search</li> </ul>   | 2              |
| 4              | Linked List <ul style="list-style-type: none"> <li>Implementation of Linked List, Singly Circular Linked List, Doubly Linked List, Doubly Circular Linked List, operations</li> </ul>   | 12             |
| 5              | Stacks and Queues <ul style="list-style-type: none"> <li>Static Stack Implementation and operations</li> <li>Dynamic Stack Implementation</li> <li>Applications of Stack -Expression Conversions</li> <li>Static Queue Implementation and operations</li> <li>Dynamic Queue Implementation</li> </ul>                       | 12             |
| 6              | Binary Trees and Binary Search Tree (Dynamic) <ul style="list-style-type: none"> <li>Operations on Binary trees – Traversing, level wise printing of nodes, counting total nodes, compute depth, Insert, Delete and search node</li> <li>BST-create, traverse, count total nodes, Insert, Delete and search node</li> </ul> | 12             |
| 7              | Graphs <ul style="list-style-type: none"> <li>Adjacency Matrix Representation</li> <li>Adjacency List Representation</li> <li>In-degree and Out-degree calculation</li> <li>BFS, DFS Implementation</li> </ul>  | 12             |

|   |                                      |  |
|---|--------------------------------------|--|
| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Second Year Bachelor of Computer Applications</b><br/> <b>CA - 221 - VSC: C++ Programing</b></p>   |                                      |  |
| <p><b>Teaching Scheme:</b><br/> <b>Practical: 04 Hrs./ Week / Batch</b></p>   | <p><b>Credits</b><br/> <b>02</b></p> | <p><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To understand Object Oriented Programming concepts using the C++.</li> <li>2. To study principles of data abstraction, inheritance and polymorphism.</li> <li>3. To learn Virtual functions and polymorphism.</li> <li>4. To know Formatted I/O and unformatted I/O.</li> </ol>  |                                      |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to,</p> <p><b>CO1:</b> Compare the procedural and object-oriented paradigms</p> <p><b>CO2:</b> Use Classes, Objects, constructors, destructors etc.</p> <p><b>CO3:</b> Illustrate the concept of function overloading, operator overloading, inheritance, virtual functions and polymorphism.</p> <p><b>CO4:</b> Apply exception handling</p> <p><b>CO5:</b> Demonstrate use of various OOPs concepts with the help of programs</p>  |                                      |  |
| <p style="text-align: center;"><b>Guidelines for Instructor's Manual</b></p> <p>The instructor shall prepare instructor's manual consisting of university syllabus, conduction and Assessment guidelines.</p>   |                                      |  |
| <p style="text-align: center;"><b>Guidelines for Student Journal</b></p> <p>The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and <b>handwritten write-up</b> of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).</p>   |                                      |  |
| <p style="text-align: center;"><b>Guidelines for Assessment</b></p> <p>The instructor shall carry out internal evaluation of laboratory assignments of 15 marks throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc.</p> <p>A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during practical examination to judge understanding of concepts by the students.</p> |                                      |  |
| <p style="text-align: center;"><b>List of Assignments</b></p> <p>The instructor shall cover necessary theoretical concepts in object-oriented programming such as objects, classes, data abstraction, encapsulation, data members, methods, access specifiers, inheritance, polymorphism, operator and function overloading, abstract classes, virtual function, file and exception handling etc.</p>   |                                      |  |

|  |   |                |
|--|---|----------------|
| <b>Topic Name</b>  | <b>Object Oriented Programming and functions in C++</b> | <b>20 Hrs.</b> |
| Assignment No 1: Creation of classes, objects, methods, access specifiers, input-output<br>Assignment No 2: Scope resolution operator, static members, call by reference<br>Assignment No 3: Inline function, friend class and function.   |   |                |
| <b>Topic Name</b>  | <b>Inheritance and Polymorphism</b>                     | <b>20 Hrs.</b> |
| Assignment No 4: Constructor and destructor<br>Assignment No 5: Single inheritance and multiple inheritance<br>Assignment No 6: Multilevel inheritance and Hierarchical Inheritance, Hybrid inheritance<br>Assignment No 7: Polymorphism (Function overloading)<br>Assignment No 8: Polymorphism (Operator overloading)  |   |                |
| <b>Topic Name</b>  | <b>File Handling and Exception Handling</b>             | <b>20 Hrs.</b> |
| Assignment No. 9: Operations on files (Read, Write, Open, Close), Random Access file functions<br>Assignment No 10: Exception handling<br>Assignment No.11: Hash tables and Dictionaries   |   |                |
| <b>Books</b>   |   |                |
| 1. B. Stroutstrup, "The C++ Programming Language", 3 <sup>rd</sup> Edition, Pearson Education, 2000.<br>2. T. Gaddis, J. Walters and G. Muganda, "OOP in C++", 7 <sup>th</sup> Edition, Pearson Education, 2010.<br>3. R. Lafore, "Object Oriented Programming in C++", 3 <sup>rd</sup> Edition, Galgotia Publications Pvt. Ltd, 2004.<br>4. Herbert Schildt, "The Complete Reference C++", 4 <sup>th</sup> Edition, Tata McGraw Hill, 2014.<br>5. Walter Savitch, "Problem solving with C++: The Object of Programming, 4 <sup>th</sup> Edition, Pearson Education, 2002. |   |                |

|   |                                      |  |
|---|--------------------------------------|--|
| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Second Year Bachelor of Computer Applications</b><br/> <b>CA - 231 - FP: Field work</b></p>  |                                      |  |
| <p><b>Teaching Scheme:</b><br/> <b>Practical: 04 Hrs./ Week</b></p>   | <p><b>Credits</b><br/> <b>02</b></p> | <p><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To provide exposure to the students and sensitize them to field issues/problems</li> <li>2. To understand methodology used to perform field work</li> </ol>  |                                      |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to</p> <p><b>CO1:</b> Apply methodology to perform field work</p> <p><b>CO2:</b> Identify and define real-world issues or problems</p> <p><b>CO3:</b> Analyze the data collected and propose solution to solve real-world problem</p>  |                                      |  |
| <p style="text-align: center;"><b>Guidelines for the faculty</b></p> <p>A faculty shall be assigned as a guide for each group of 3 / 4 students.<br/> The guide assigned for each group shall assist the assigned student group(s) for identifying topic/area (topic list is provided below for reference) for the field work, objectives and outcomes, preparation of questionnaire, resources/tools needed and guide the students for possible solutions and report preparation<br/> The guide assigned for each group shall monitor, track and assess the progress of work carried out by students throughout the semester</p>   |                                      |  |
| <p style="text-align: center;"><b>Guidelines for Students</b></p> <p>The student shall work in a group of 3 or 4 students. Each group shall select topic/area for the fieldwork to be undertaken by them in consultation with their assigned guide.<br/> The group shall discuss and decide objectives, outcomes, overall plan for fieldwork, methodology to be adopted, such as preparation of a questionnaire for conduction of survey or methods for data gathering, tools to be used for analysis etc. and get the plan approved from their guide.<br/> Each group shall carry out fieldwork during their free slots, or before/after college hours or on Sundays or holidays. The students shall maintain a diary giving details of tasks performed by them, observations/study notes etc.<br/> The suggested timelines for the field work are</p> <ul style="list-style-type: none"> <li>• Formation of group – 1 week</li> <li>• Selection of topic for field study – 2 Week</li> <li>• Discussions and finalization of objectives, outcomes and methodology to be used – 3 Weeks</li> <li>• Field work and visits, SWOT/SWOC analysis, group discussions and meeting with guide – Conduction of survey / gathering data etc. – 4 Weeks</li> <li>• Preparation of report and presentation – 2 weeks</li> </ul> <p>Each group shall submit a report at the end of the semester consisting of Title, Abstract, Rational of the study, problem definition, objectives, outcomes, methodology used, details of field work performed (Field Visits, Interviews, discussions etc.), analysis, SWOT/SWOC, findings, details of proposed solution (Paper design/prototype/mobile App etc.) and conclusions. Students should also submit geo-tagged photographs, audio-video clips etc.</p> |                                      |  |

### **Guidelines for Assessment**

The instructor shall carry out internal evaluation of fieldwork for 15 marks throughout the semester based on timely completion of the work, analysis, findings and neatness of the report etc.

The end semester examination of 35 marks shall be based on Group presentation and the reports of fieldwork submitted in the journal.

### **List of suggested topics/areas for Field work (but not limited to)**

1. Healthcare (Civil and private hospitals) – HIMS, Telemedicine etc.
2. Schools, colleges, Universities - e-Learning Platforms, MOOCs, ERP, IT Infrastructure and Security systems etc.
3. Agriculture - Use of IoT Devices, drones in Agriculture, Management of Water Distribution, etc.
4. Old age homes and organizations working of differently abled people - Assistive Technologies for Divyanga Personnel, Support for Senior Citizens etc.
5. Organizations/NGOs working on food habits, nutrition, adulterations
6. Urban Region - Smart Cities, Traffic Management, Renewable energy and Solar Systems, Waste collection and disposal, studying water quality and water supply system of the city etc.
7. Rural Region - Smart Villages, Agriculture Product Distribution Systems etc.
8. Government offices and offices of Local Bodies (Corporation/Municipal Corporation/ Grampanchayat - ERP, IT Infrastructure and Security etc.
9. Pollution control boards – study / develop a system to monitor City environmental parameters - Air/Sound/Water pollutions
10. Department of disaster Management – Study /develop response system for allocating resources during natural disasters.
11. Governance - e-Governance Portals, Online Payment Systems etc.
12. Industries (IT/Manufacturing/Telecomm) involved in development of solutions to solve social issues

### **BOOKS**

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017



| Savitribai Phule Pune University<br>Second Year Bachelor of Computer Applications<br>CA – 200 – IKS: Indian Knowledge System for Computing  |  |   |
|---|--|---|
| <b>Teaching Scheme:</b><br>Theory: 02 Hrs./Week   | <b>Credits</b><br>02                           | <b>Examination Scheme:</b><br>Continuous Evaluation: 15 Marks<br>End-Semester: 35 Marks |
| <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To study contributions of Indian scholars to computation and logic.</li> <li>2. To understand Indian methods for Number representations</li> <li>3. To know use of Sanskrit in Natural language processing</li> <li>4. To learn ancient cryptography techniques</li> </ol>  |  |   |
| <b>Course Outcomes:</b> After successful completion of this course, the learners will be able to<br><b>CO1:</b> List India's contributions to Computing<br><b>CO2:</b> Apply Ancient Indian Mathematical concepts in Computing<br><b>CO3:</b> Utilize Linguistic and Computational aspects of Sanskrit from IKS in Modern Computing<br><b>CO4:</b> Describe Cryptographic techniques from IKS<br><b>CO5:</b> Make use of Cybersecurity techniques from IKS<br><b>CO6:</b> Illustrate the Role of IKS in Emerging Technologies                                 |  |   |
| Course Contents   |  |   |
| Unit I  | Introduction to Indian Knowledge Systems (IKS) | 05Hrs.  |
| 1.1 Introduction IKS<br>1.2 Defining Indian Knowledge System (IKS) and its components,<br>1.3 Contribution of Aryabhata and Brahmagupta, Buddhist logico-epistemology<br>1.4 The knowledge triangle<br>1.5 Prameya -A vaiśeṣikan approach to physical reality<br>1.6 Dravyas -the constituents of the physical reality<br>1.7 Attributes -the properties of substances and Action -the driver of conjunction and disjunction<br>1.8 sāmānya, viśēṣa, samavāya<br>1.9 Pramāṇa -the means of valid knowledge<br>1.10 Samsaya-ambiguities in existing knowledge. |  |   |
| Unit II   | Number Systems and Units of Measurement        | 12 Hrs.   |
| 2.1 Number systems in India -Historical evidence<br>2.2 Salient Features of the Indian Numeral System <ol style="list-style-type: none"> <li>2.2.1 Concept of zero and its importance,</li> <li>2.2.2 Large numbers and their representation</li> <li>2.2.3 Place Value of Numerals</li> <li>2.2.4 Decimal System</li> </ol> 2.3 Unique approaches to represent Numbers <ol style="list-style-type: none"> <li>2.3.1 Bhūta-Saṃkhyā system</li> </ol>  |  |   |

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|--|--|----------------|
| 2.3.2 Śūnyabindu System<br>2.3.3. Piṅgala and the Binary system<br>2.4. Measurements for time, distance, and weight in ancient India   |  |                |
| <b>Unit III</b>  | <b>Linguistics</b>                               | <b>08 Hrs.</b> |
| 3.1 Introduction to Linguistics<br>3.2 Aṣṭādhyāyī<br>3.3 Phonetics<br>3.4 Word generation<br>3.5 Computational aspects<br>3.6 Mnemonics<br>3.7 Recursive operations -Introduction to use of Kaprekar Constant 6174 in recursion<br>3.8 Rule based operations<br>3.9 Sentence formation<br>3.10 Verbs and prefixes<br>3.11 Role of Sanskrit in natural language processing          |  |                |
| <b>Unit IV</b>   | <b>Ancient Cryptography and Security Systems</b> | <b>05 Hrs.</b> |
| 4.1 The Evolution of India's Intelligence Culture-Kautilya's Discourse on Secret Intelligence in the Arthashastra<br>4.2 Kaṭapayādi system<br>4.3 Steganography in Kautilya's Arthashastra<br>4.4 Cryptographic methods in ancient Indian texts<br>4.5 Relevance to modern-day cybersecurity and encryption<br>4.6 Introduction to use of Kaprekar Constant (6174) in cryptography |  |                |
| <b>Books</b>   |  |                |
| 1. B. Mahadevan, Vinayak Rajat Bhat, and R.N. Nagendra Pavana, "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning, 2022.<br>2. Dee Hetvik, "Ancient Indian encryption: KaTaPaYadi system", Kindle Edition<br>3. <a href="https://www.geeksforgeeks.org/kaprekar-constant/">https://www.geeksforgeeks.org/kaprekar-constant/</a>                    |  |                |

# Detailed Drafts

For

## Level 5.0 (SY)

  

# SEMESTER IV

| <b>Savitribai Phule Pune University</b><br><b>Second Year Bachelor of Computer Applications</b><br><b>CA - 251- MJ: Database Management Systems</b>  |  |   |
|--|--|---|
| <b>Teaching Scheme:</b><br><b>Theory: 04 Hrs./Week</b>   | <b>Credits</b><br><b>04</b>                      | <b>Examination Scheme:</b><br><b>Continuous Evaluation: 30 Marks</b><br><b>End-Semester: 70 Marks</b> |
| <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To understand the fundamental concepts of Relational database management systems</li> <li>2. To study and understand systematic approaches for design of database systems</li> <li>3. To learn SQL - the database Query language</li> <li>4. To know about transaction management and data security</li> </ol>   |  |   |
| <b>Course Outcomes:</b> After successful completion of this course, learner will be able to<br><b>CO1:</b> Solve real world problems using appropriate relational data model.<br><b>CO2:</b> Construct E-R Model for given requirements and convert it into database tables.<br><b>CO3:</b> Write efficient SQL queries and use PL/SQL<br><b>CO4:</b> Apply database management operations<br><b>CO5:</b> Describe mechanisms for transaction management<br><b>CO6:</b> Demonstrate understanding of database security   |  |   |
| <b>Unit I</b>  | <b>Introduction</b>                              | <b>06 Hrs.</b>  |
| 1.1 Introduction to DBMS<br>1.2 File system Vs. DBMS<br>1.3 Data models -relational, hierarchical, network<br>1.4 Levels of abstraction<br>1.5 Data independence<br>1.6 Structure of DBMS<br>1.7 Users of DBMS<br>1.8 Advantages and disadvantages of DBMS   |  |   |
| <b>Unit II</b>   | <b>Conceptual and Relational Database Design</b> | <b>12 Hrs.</b>  |
| 2.1 Overview of DB design process.<br>2.2 Introduction to data models (E-R model, Relational model, Network model, Hierarchical model)<br>2.3 Conceptual design using ER data model (entities, attributes, entity sets, relations, relationship sets) and symbols. Extended ER Features, ER to Relational Mapping<br>2.4 Constraints (Key constraints, Integrity constraints, referential integrity, unique constraint, Null/Not Null Constraint, Domain Constraint, Check constraint, Mapping constraints, Column level and Table Level Constraint)<br>2.5 Keys in Database (primary key, foreign key, Candidate key, super key)<br>2.6 Extended features - Specialization, Aggregation, Generalization (Pictorial representation).<br>2.7 Structure of Relational Databases (concepts of a table)<br>2.8 Concept of Normalization -Normal forms (only definitions) with example (1NF,2NF,3N, |  |   |

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|-----------------|--|----------------|
|                 | BCNF, 4NF)   |                |
| 2.9             | Functional dependency - Concept, Closure of Attribute set, Armstrong axioms, Closure of relation( $F^+$ )              |                |
| 2.10            | Decomposition - Concept, Properties of Decomposition (Lossless joins and Dependency preservation)                      |                |
| <b>Unit III</b> | <b>Structured Query Language (SQL)</b>   | <b>10 Hrs.</b> |
| 3.1             | Introduction to SQL.   |                |
| 3.2             | DDL commands with examples (Create, Drop, Alter)   |                |
| 3.3             | DML commands with examples (Insert, Update, Delete)  |                |
| 3.4             | Basic structure of SQL Select query  |                |
| 3.5             | SQL Operations (Aggregate functions, Set operations, Date, Time, String functions and Null values, Nested Sub queries) |                |
| 3.6             | Join Queries (Cartesian Product, Inner joins, Outer - Left, Right, Full)   |                |
| 3.7             | Views (Create, Alter, Drop)  |                |
| 3.8             | Examples on SQL (case studies)   |                |
| <b>Unit III</b> | <b>Structured Query Language (SQL)</b>   | <b>10 Hrs.</b> |
| 3.1             | Introduction to SQL.   |                |
| 3.2             | DDL commands with examples (Create, Drop, Alter)   |                |
| 3.3             | DML commands with examples (Insert, Update, Delete)  |                |
| 3.4             | Basic structure of SQL Select query  |                |
| 3.5             | SQL Operations (Aggregate functions, Set operations, Date, Time, String functions and Null values, Nested Sub queries) |                |
| 3.6             | Join Queries (Cartesian Product, Inner joins, Outer - Left, Right, Full)   |                |
| 3.7             | Views (Create, Alter, Drop)  |                |
| 3.8             | Examples on SQL (case studies)   |                |
| <b>Unit IV</b>  | <b>Introduction to PL/Postgres SQL</b>   | <b>12 Hrs.</b> |
| 4.1             | PL/Postgres SQL: Language structure  |                |
| 4.2             | Control structures (Conditional Statements and loops)  |                |
| 4.3             | Stored Procedures.   |                |
| 4.4             | Functions  |                |
| 4.5             | Handling errors and exceptions   |                |
| 4.6             | Cursors  |                |
| 4.7             | Triggers   |                |
| <b>Unit V</b>   | <b>Transaction Management</b>  | <b>12 Hrs.</b> |
| 5.1.            | Transaction  |                |
|                 | 5.1.1.1.1 Properties of transaction  |                |
|                 | 5.1.1.1.2 States of transactions   |                |
|                 | 5.1.1.1.3 Concurrent execution of transactions   |                |
|                 | 5.1.1.1.4 Conflicting operations   |                |
| 5.2             | Schedules  |                |
|                 | 5.2.1.1.1 Types of schedules   |                |

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| 5.3            | Concept of serializability<br>5.3.1 Precedence graph for serializability  |               |
| 5.4            | Basic timestamp protocol for concurrency, Thomas Write Rule.  |               |
| 5.5            | Two-phase Locking protocol, Timestamps vs. Locking.   |               |
| 5.6            | Deadlock and Deadlock Handling - Deadlock Avoidance, Deadlock Detection and Deadlock Recovery   |               |
| 5.7            | Log Base Recovery Techniques - Deferred and Immediate Updates   |               |
| <b>Unit VI</b> | <b>Database Security</b>  | <b>8 Hrs.</b> |
| 6.1            | Introduction to database security concepts  |               |
| 6.2            | Methods for database security   |               |
| 6.3            | Access Control Method<br>6.3.1 Discretionary access control method<br>6.3.2 Mandatory access control<br>6.3.3 Role based access control for multilevel security |               |
| 6.4            | Use of views in security enforcement  |               |
| 6.5            | Overview of encryption technique for security   |               |
| 6.6            | Statistical database security.  |               |
| <b>Books</b>   |   |               |
| 1.             | Silberschatz, Korth, and Sudarshan, "Database System Concepts", 6 <sup>th</sup> Edition, McGraw-Hill, 2011  |               |
| 2.             | Elmasri and Navathe, "Fundamentals of Database Systems", 7 <sup>th</sup> Edition, Pearson, 2017   |               |
| 3.             | Ramakrishnan and Gerkhe, "Database Management Systems", 3 <sup>rd</sup> Edition, Tata McGraw Hill, 2002   |               |
| 4.             | Desai Bipin, "Introduction to Database Management System", 1 <sup>st</sup> Edition, Galgotia Publication, 2008  |               |
| 5.             | Date, C. J., Kannan and Swamynathan, "An Introduction to Database Systems", 8 <sup>th</sup> Edition, Pearson, 2006  |               |
| 6.             | Drake and Worsley, "Practical PostgreSQL", O'Reilly Publications, 2002  |               |
| 7.             | Kahate, "Introduction to Database Management Systems", 1 <sup>st</sup> Edition, Pearson Education, 2004   |               |
| 8.             | Singh, S. K., "Database Systems: Concepts, Design and Application", 2 <sup>nd</sup> Edition, Pearson, 2011  |               |

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| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Second Year Bachelor of Computer Applications</b><br/> <b>CA – 252 - MJP: Lab course on CA - 251 - MJ</b></p>  |  |  |
| <p style="text-align: center;"><b>Teaching Scheme</b><br/> <b>Lab: 04 Hrs./ Week/ Batch</b></p>   | <p style="text-align: center;"><b>Credits</b><br/> <b>02</b></p>             | <p style="text-align: center;"><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To study DDL and DML Queries</li> <li>2. To understand SQL and PL/SQL</li> </ol>   |  |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, learner will be able to</p> <p><b>CO1:</b> Design E-R Model for given requirements and convert the same into database tables.</p> <p><b>CO2:</b> Design and create relational database systems.</p> <p><b>CO3:</b> Use SQL DDL and DML commands</p> <p><b>CO4:</b> Apply constructs in PL/PGSQL</p>  |  |  |
| <p style="text-align: center;"><b>Guidelines for Instructor's Manual</b></p> <p>The instructor shall prepare instructor's manual consisting of University syllabus, conduction and Assessment guidelines.</p>   |  |  |
| <p style="text-align: center;"><b>Guidelines for Student Journal</b></p> <p>The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and <b><u>handwritten write-up</u></b> of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).</p>  |  |  |
| <p style="text-align: center;"><b>Guidelines for Assessment</b></p> <p>The instructor shall carry out internal evaluation of laboratory assignments of 15 marks throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc.</p> <p>A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during the practical examination to judge understanding of concepts by the students.</p> |  |  |
| <p style="text-align: center;"><b>List of Assignments</b></p>   |  |  |
| <p style="text-align: center;"><b>Assignment No 1</b></p>   | <p style="text-align: center;"><b>Simple table design (DDL) Commands</b></p> | <p style="text-align: center;"><b>4 Hrs.</b></p>   |
| <p>Create simple tables including all data types.</p> <ul style="list-style-type: none"> <li>• Primary key constraint (as a table level constraint and as a column level constraint)</li> <li>• Check constraint (All types)</li> <li>• Unique constraint, Null/Not null constraint</li> </ul>  |  |  |

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| <b>Assignment No 2</b>   | <b>Simple tables using referential constraint (DDL) commands</b> | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Create more than one table and access them using referential integrity constraint.</li> </ul>   |  |                |
| <b>Assignment No 3</b>   | <b>DDL commands</b>  | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Drop a table, Alter schema of a table.</li> <li>Insert / Update / Delete records using tables created in previous Assignments</li> </ul>  |  |                |
| <b>Assignment No 4</b>   | <b>DML commands</b>  | <b>8 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Write queries on the tables using SQL select query <ul style="list-style-type: none"> <li>Select &lt;field-list&gt; from table [where &lt;condition&gt; order by &lt;field list&gt;], Select &lt;field-list, aggregate functions&gt; from table [where &lt;condition&gt; group by &lt;&gt; having &lt;&gt; order by &lt;&gt;]</li> </ul> </li> <li>To create views and retrieve data using the views</li> </ul> |  |                |
| <b>Assignment No 5</b>   | <b>DML commands</b>  | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Write queries using set operations (minus operation, union, union all, intersect, intersect all)</li> </ul>   |  |                |
| <b>Assignment No 6</b>   | <b>Nested Queries</b>  | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Write nested queries using Except, Except all, Exists, Not exists etc.</li> </ul>   |  |                |
| <b>Assignment No 7</b>   | <b>Stored Procedure</b>  | <b>6 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Create a Simple Stored Procedure</li> <li>Create a Stored Procedure with IN, OUT and IN/OUT parameter</li> </ul>  |  |                |
| <b>Assignment No 8</b>   | <b>Function</b>  | <b>6 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Create and use a Simple Stored Function</li> <li>Create and use a simple Stored Function that returns</li> <li>Create and use a simple Stored recursive Function</li> </ul>   |  |                |
| <b>Assignment No 9</b>   | <b>Cursor</b>  | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Create and use a Simple Cursor</li> <li>Create and use a Parameterized Cursor</li> </ul>  |  |                |
| <b>Assignment No 11</b>  | <b>Exception Handling</b>  | <b>4 Hrs.</b>  |
| <ul style="list-style-type: none"> <li>Create and use a Simple Exception-Raise Debug Level Messages</li> <li>Create and use a Simple Exception-Raise Notice Level Messages</li> <li>Create and use a Simple Exception-Raise Exception Level Messages</li> </ul>  |  |                |
| <b>Assignment No 12</b>  | <b>Triggers</b>  | <b>10 Hrs.</b> |
| <ul style="list-style-type: none"> <li>Create and perform insert, update, delete using a Before Trigger &amp; an After Trigger</li> <li>Creating EER Diagram and schemas using MySQL- Workbench or any such tools</li> <li>Store data in simple DBMS and retrieve it in spreadsheets using SQL query</li> </ul>  |  |                |



| Savitribai Phule Pune University<br>Second Year Bachelor of Computer Applications<br>CA – 271 - VSC: Python Programming  |                             |  |
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| <b>Teaching Scheme:</b><br><b>Practical: 04 Hrs./ Week/ Batch</b>  | <b>Credits</b><br><b>02</b> | <b>Examination Scheme:</b><br><b>Continuous Evaluation:15 Marks</b><br><b>End-Semester: 35 Marks</b> |
| <b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To introduce programming concepts using Python</li> <li>2. To understand various constructs in Python</li> <li>3. To test and execute Python programs.</li> </ol>  |                             |  |
| <b>Course Outcomes:</b> After successful completion of this course, the learners will be able to<br><b>CO1:</b> Write Python programs to solve a given problem<br><b>CO2:</b> Choose appropriate data structures such as lists, dictionaries, tuples, and sets.<br><b>CO3:</b> Develop Python programs to implement the given small applications.  |                             |  |
| <b>Guidelines for Instructor's Manual</b><br>The instructor shall prepare instructor's manual consisting of University syllabus, conduction and Assessment guidelines.   |                             |  |
| <b>Guidelines for Student Journal</b><br>The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and <b>handwritten write-up</b> of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).   |                             |  |
| <b>Guidelines for Assessment</b><br>The instructor shall carry out internal evaluation of laboratory assignments of 15 marks throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc.<br><br>A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during practical examination to judge understanding of concepts by the students. |                             |  |

### List of assignments

The instructor shall cover theoretical aspects such as Data types, declarations, input / output, control flow, Strings and Functions List, Tuples, Dictionary and Sets etc.

| Assignment No. | Topics for the Assignments       | Number of Hrs. |
|----------------|----------------------------------|----------------|
| 1              | Basic Python                     | 06             |
| 2              | Control structures and operators | 08             |
| 3              | Python Strings                   | 08             |
| 4              | Python Functions                 | 08             |
| 5              | Python Lists                     | 08             |
| 6              | Python Tuples                    | 08             |
| 7              | Python Dictionary                | 08             |
| 8              | Python Sets                      | 06             |
| <b>Total</b>   |                                  | <b>60</b>      |

### BOOKS

1. Montojo, Jason, Campbell, Jennifer and Gries Paul, "Practical Programming: An Introduction to Computer Science using Python 3", 2<sup>nd</sup> Edition, O'Reilly, 2013
2. Payne James, "Beginning Python: Using Python and Python 3.1", 1<sup>st</sup> Edition, Wrox Publication, 2010
3. Dierbach Charles, "Introduction to Computer Science Using Python", 1<sup>st</sup> Edition, Wiley Publication, 2015
4. Balagurusamy E., "Introduction to Computing and Problem-Solving using Python, 1<sup>st</sup> Edition, Tata McGraw Hill publication, 2017
5. Mueller John P., "Beginning Programming with Python for Dummies", 1<sup>st</sup> Edition, Dummies, 2014

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| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Second Year Bachelor of Computer Applications</b><br/> <b>CA – 271 - CEP: Community services</b></p>   |                                      |  |
| <p><b>Teaching Scheme:</b><br/> <b>Practical: 04 Hrs./ Week</b></p>   | <p><b>Credits</b><br/> <b>02</b></p> | <p><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To provide exposure to the students and sensitize them for community issues/problems</li> <li>2. To know levels of community engagements (Informative, participative and decision-making participations)</li> </ol>  |                                      |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to</p> <p><b>CO1:</b> Identify and define community engagement service to address community problem</p> <p><b>CO2:</b> Choose appropriate community engagement level to solve the problem</p> <p><b>CO3:</b> Analyze and propose possible solution to solve community problem</p>  |                                      |  |
| <p style="text-align: center;"><b>Guidelines for the faculty</b></p> <p>A faculty shall be assigned as a guide for each group of 3 / 4 students.</p> <p>The guide assigned for each group shall assist the assigned student group(s) for identifying topic/area (topic list is provided below for reference) for the community engagements, objectives and outcomes, preparation of questionnaire, resources/tools needed and guide the students for possible solutions and report preparation. The guide assigned for each group shall monitor, track and assess the progress of work carried out by students throughout the semester</p>  |                                      |  |
| <p style="text-align: center;"><b>Guidelines for Students</b></p> <p>The student shall work in a group of 3 or 4 students. Each group shall select topic/area for the community engagement to be undertaken in consultation with their assigned guide.</p> <p>The group shall discuss and decide objectives, outcomes, overall plan for possible activities during community engagement, methodology to be adopted, such as preparation of a questionnaire for conduction of survey or methods for data gathering, tools to be used for analysis etc. and get the plan approved from their guide.</p> <p>Each group shall carry out activities during their free slots, or before/after college hours or on Sundays or holidays. The students shall maintain a diary giving details of tasks performed by them, observations/study notes etc.</p> <p>The suggested timelines for the field work are</p> <ul style="list-style-type: none"> <li>• Formation of group – 1 week</li> <li>• Selection of topic for community engagement – 2 Week</li> <li>• Discussions and finalization of objectives, outcomes and methodology to be used – 3 Weeks</li> <li>• Activities for community engagement - Conduction of survey / gathering data, Awareness programs, interviews, group discussions and meeting with guide — 4 Weeks</li> <li>• Preparation of report and presentation – 2 weeks</li> </ul> <p>Each group shall submit a report at the end of the semester consisting of Title, Abstract, Rational of the study, problem definition, objectives, outcomes, methodology used, details of activities undertaken, analysis, findings, details of proposed solution (paper design/prototype/mobile app etc.) and conclusions. Students should also submit photographs, audio-video clips etc.</p> |                                      |  |

### **Guidelines for Assessment**

The instructor shall carry out internal evaluation of work for 15 marks throughout the semester based on timely completion of the work, analysis, findings and neatness of the report etc.

The end semester examination of 35 marks shall be based on group presentation and the reports of activities participated.

#### **List of suggested topics/areas for Community Services (but not limited to)**

1. Schools and colleges – Awareness about environment issues, cyber security, health and nutrition, new policies by government, Training programs for students and teachers, etc.
2. Agriculture - Awareness programs for farmers, in association with agriculture officers on Plantation and Soil protection, Bio-diversity, Organic farming, promotion of local crops, marketing, sales and logistics for agro products etc.
3. Old age homes and organizations working of differently abled people – Awareness programs for Senior Citizens and differently abled people and their interviews etc.
4. Organizations/NGOs working on food habits, nutrition, adulterations – Awareness programs for students staying in hostels
5. Urban Region - Smart Cities, Traffic Management, Renewable energy and Solar Systems - Interviews with officers and citizens, social and community leaders, Drives for waste collection and disposal, testing water quality Drives for River and garden Cleaning, etc.
6. Government offices and offices of Local Bodies (Corporation/Municipal Corporation/ Grampanchayat – Interviews with officers and devise mechanism for promotion of Schemes and services for citizens through websites, street plays etc.
7. Pollution control boards – Interviews with officers and arranging drives/awareness programs for Air/Sound/Water pollutions
8. Department of disaster Management – Arranging mock drills
9. Office of Local city bus transportation – Interviews with officers, employees and passengers and suggest solutions with optimised bus routes, frequency, stoppages and fairs
10. Prominent Local social events such as “Sinhasta Kumbhamela”, “Pundharpur Vari” etc. – Crowd and traffic management, surveillance, security, Environmental issues etc.
11. Women education and empowerment – Training programs for house wives and Mahila Udyog and Bachat Gat
12. Community engagement platforms – Study / develop platform for community members to report issues, share ideas and collaborate on local issues.
  - Colleges to try adopting a village or a nearby community through conduction of workshops or awareness drives on topics such as digital literacy, environmental sustainability, mental health, career guidance and planning for local stakeholders

#### **BOOKS**

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.
2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.
3. Design Thinking for Social Innovation. IDEO Press, 2015.
4. Dostilio, L. D., et al. The Community Engagement Professional's Guidebook: A Companion to The Community Engagement Professional in Higher Education. Stylus Publishing, 2017

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| <p align="center"><b>Savitribai Phule Pune University</b><br/> <b>Second Year Bachelor of Computer Applications</b><br/> <b>CA – 251 - SEC: Spreadsheet Applications</b></p>   |   |   |
| <p align="center"><b>Teaching Scheme</b><br/> <b>Practical: 04 Hrs./ Week / Batch</b></p>  | <p align="center"><b>Credits</b><br/> <b>02</b></p> | <p align="center"><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To know Excel interface, basic and advanced Data Entry and Formatting</li> <li>2. To understand Excel Formulas and Functions, Charts</li> <li>3. To learn to automate tasks with Macros and VBA</li> </ol>  |   |   |
| <p><b>Course Outcomes:</b></p> <p>After successful completion of this course, the learners will be able to -</p> <p><b>CO1:</b> Navigate and utilize spreadsheet applications effectively for data organization and management</p> <p><b>CO2:</b> Apply formulas, functions and logical operations to automate tasks.</p> <p><b>CO3:</b> Analyze and visualize data using charts, pivot tables and conditional formatting</p> <p><b>CO4:</b> Implement data validation, sorting and filtering for efficient data handling</p> <p><b>CO5:</b> Develop practical spreadsheet solutions for business scenarios like financial planning, inventory management and project management.</p>  |   |   |
| <p align="center"><b>Guidelines for Instructor's Manual</b></p> <p>The instructor shall prepare instructor's manual consisting of University syllabus, conduction and Assessment guidelines.</p>   |   |   |
| <p align="center"><b>Guidelines for Student Journal</b></p> <p>The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and <b>handwritten write-up</b> of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).</p>   |   |   |
| <p align="center"><b>Guidelines for Assessment</b></p> <p>The instructor shall carry out internal evaluation of laboratory assignments of 15 marks throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc.</p> <p>A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during practical examination to judge understanding of concepts by the students.</p> |   |   |
| <p align="center"><b>List of Assignments</b></p> <ol style="list-style-type: none"> <li>1. Create, Open, Save Spreadsheet, Basic Data Entry and Formatting and conditional formatting, Formula and function, Sorting, importing data from various formats (csv/text)</li> </ol>  |   |   |

2. Lookup and Reference Functions - VLOOKUP, HLOOKUP, XLOOKUP
3. INDEX and MATCH (for dynamic lookups) - INDIRECT, OFFSET, CHOOSE
4. Logical Functions - IF, AND, OR, XOR, IFERROR, IFS
5. Text Functions - CONCAT, TEXTJOIN, PROPER, LEFT, RIGHT, MID
6. Date and Time Functions - TODAY, NOW, EOMONTH, NETWORKDAYS
7. Math and Statistical Functions - SUMIF, COUNTIF, AVERAGEIF RANK, LARGE, SMALL
8. Array Formulas and Dynamic Arrays
  - a. Basic example of Arrays using ctrl + shift + enter
  - b. Array with if, len function and mid function formula
  - c. Advanced use of formula with Array.
9. Power Query for Data Cleaning
  - a. Automates data cleaning and transformation.
  - b. Can merge, split, remove duplicates, and reshape data.
10. Histogram, Waterfall, Gantt and Combo Charts
11. Pivot Tables
  - a. Creating simple Pivot Tables
  - b. Basic and Advanced value field
  - c. Classic Pivot Tables
  - d. Filtering Pivot Tables
  - e. Modifying Pivot Tables
  - f. Grouping data in pivot table based on numbers, category and Dates
12. VBA
  - a. Creating a Macro, Procedures and Functions in VBA, Variables in VBA
  - b. If statement and Select statement - if and Else if, Select case Statement
  - c. Loops in VBA - For and Do loop, Exit Loop, Advanced Loop
  - d. Mail Functions in VBA - Send automated mail, Merge multiple excel files into one sheet, Split worksheets using VBA filters
13. Micro Projects
  - a. Financial Calculation and Budget Planning or
  - b. Sales and Inventory Management or
  - c. Project and Time Management

## Books

1. Alexander, Michael and Kusleika, Dick, "Excel 365 Bible", 2<sup>nd</sup> Edition, John Wiley & Sons, 2022
2. Mc, Fedries and Greg Harvey, "Excel All-in-One for Dummies", 1<sup>st</sup> Edition, Dummies, 2021
3. Holler, James., "Office 365 Bible", James Publication, 2024
4. Global, Emenwa., "Excel in 7 Days", Independently, 2022
5. Hong, Bryan., "101 Excel Formulas Guide", Independently, 2019

**List of MINOR Courses offered  
by BOS in Computer Applications (FoS&T)  
to any other BOS under FoS&T or any Faculty except FoS&T**

| Sr. No. | Semester | Course Code | Course Name  | Credits |    |       |
|---------|----------|-------------|--|---------|----|-------|
|         |          |             |  | TH      | PR | Total |
| 1       | III      | CA-241-MN   | Programming with Python                                      | 02      | 00 | 02    |
| 2       | III      | CA-242-MN   | Lab course on Programming with Python                        | 00      | 02 | 02    |
| 3       | IV       | CA-291-MN   | Introduction to Artificial Intelligence and Machine Learning | 02      | 00 | 02    |
| 4       | IV       | CA-292-MN   | Lab course on Artificial Intelligence and Machine Learning   | 00      | 02 | 02    |

**List of Open Elective (OE) Courses offered  
by BOS in Computer Applications  
to any Faculty except FoS&T**

| Sr. No. | Semester | Course Code | Course Name                              | Credits |    |       |
|---------|----------|-------------|--|---------|----|-------|
|         |          |             |  | TH      | PR | Total |
| 1.      | III      | OE-201-CA   | Introduction to Artificial Intelligence  | 02      | 00 | 02    |
| 2.      | IV       | OE-251-CA   | Software Tools for Office Administration | 00      | 02 | 02    |

Detailed Drafts Of  
Minor Courses offered  
by BOS (Computer Applications)  
to  
any other BOS under FoS&T or any  
faculty except FoS&T  
for  
SEMESTER III and IV only



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| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Minor Course offered by BOS (Computer Applications) to any other BOS</b><br/> <b>under FoS&amp;T or any faculty except FoS&amp;T for</b><br/> <b>SEMESTER III only</b><br/> <b>CA – 241 – MN: Programming with Python</b></p>  |  |  |
| <p style="text-align: center;"><b>Teaching Scheme:</b><br/> <b>Theory: 02 Hrs./ Week</b></p>  | <p style="text-align: center;"><b>Credits</b><br/> <b>02</b></p> | <p style="text-align: center;"><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce programming concepts using Python</li> <li>2. To understand various constructs in Python</li> <li>3. To test and execute Python programs.</li> </ol>  |  |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to:</p> <p><b>CO1:</b> Write Python programs to solve the given problem</p> <p><b>CO2:</b> Utilize the data structures such as lists, dictionaries, tuples and sets.</p> <p><b>CO3:</b> Use built-in and user defined modules and packages.</p> <p><b>CO4:</b> Apply operations involving file systems and data handling.</p>  |  |  |
| <b>Course Contents</b>  |  |  |
| <b>Unit I</b>   | <b>Introduction to Python</b>                                    | <b>5 Hrs.</b>  |
| <ol style="list-style-type: none"> <li>1.1 Introduction <ol style="list-style-type: none"> <li>1.1.1. Python identifiers and reserved words</li> <li>1.1.2. Lines and indentation, multi-line statements and Comments</li> <li>1.1.3. Input/output with print and input functions</li> <li>1.1.4. Command line arguments and processing command linear arguments</li> </ol> </li> <li>1.2 Data Types <ol style="list-style-type: none"> <li>1.2.1 Standard data types -basic, none, Boolean, numbers</li> <li>1.2.2. Data type conversion</li> </ol> </li> <li>1.3 Operators <ol style="list-style-type: none"> <li>1.3.1: Basic operators (Arithmetic, comparison, assignment, bitwise, logical)</li> <li>1.3.2 Membership operators (in, not in)</li> <li>1.3.3. Identity operators (is, is not)</li> </ol> </li> <li>1.4 Control Statement <ol style="list-style-type: none"> <li>1.4.1 Conditional/decision statements (if, if—else, elif,</li> <li>1.4.2. Loop Control Structure (while, Do--while, for)</li> <li>1.4.3 Selection Control Statement (Switch case, Pass, Continue, Break)</li> </ol> </li> <li>1.5 Basic Object-Oriented Programming Concepts in Python <ol style="list-style-type: none"> <li>1.5.1 Creating classes, instance, objects, accessing members</li> <li>1.5.2 Data hiding (the double underscore prefix)</li> <li>1.5.3 Built-in class attributes</li> </ol> </li> </ol> |  |  |

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| 1.5.4 Garbage collection<br>1.5.5 Constructor<br>1.6 Applications of Python  |                                  |               |
| <b>Unit II</b>   | <b>Functions and Strings</b>     | <b>7 Hrs.</b> |
| 2.1 Introduction to function<br>2.1.1 Defining a function, calling a function<br>2.1.2 Types of function (Built-in, function, user-defined function, lambda function /anonymous function, recursive function)<br>2.1.3 Function arguments<br>2.1.4 Global and Local variable, Examples<br>2.1.5 Math Functions<br>2.1.6 Functional programming tools -filter( ), map( ), and reduce( )<br>2.2 Introduction to string<br>2.2.1 Declaration and String manipulation -Accessing String, String Slices.<br>2.2.2 Documentation Strings-Single quotes, Double quotes, Triple quotes, Raw String<br>2.2.3 Python string operators, escape character<br>2.2.4 String formatting operator<br>2.2.5 Built-in String functions / Methods |                                  |               |
| <b>Unit III</b>  | <b>Tuple, Set and Dictionary</b> | <b>8 Hrs.</b> |
| 3.1 Introduction to tuple<br>3.1.1 Tuple definition, accessing tuple values, update and delete tuple elements<br>3.1.2 Basic Tuple operations<br>3.1.3 Tuple -Indexing and slicing<br>3.1.4 Built in tuple functions<br>3.1.5 Applications of tuple<br>3.2 Introduction to set<br>3.2.1 Create, update and remove elements from set<br>3.2.2 Set operations<br>3.2.3 Set built-in functions<br>3.2.4 Applications of set<br>3.3 Introduction to Dictionary<br>3.3.1 Creating and accessing values in a dictionary<br>3.3.2 Updating dictionary, delete dictionary elements<br>3.3.3 Properties of dictionary keys<br>3.3.4 Built-in dictionary functions and methods   |                                  |               |
| <b>Unit IV</b>   | <b>Modules and Packages</b>      | <b>4 Hrs.</b> |
| 4.1 Introduction to Module<br>4.2 Types of Module and Examples<br>4.2.1 Built_in Module (Math module, Random module, Time module, regular expression)  |                                  |               |

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| 4.2.2 User Defined Module (creation and import)<br>4.2.3 External Module (Python libraries-NumPy, Pandas, Matplotlib, Seaborn)<br>4.3 Introduction to Package<br>4.3.1 Importing and creating package<br>4.3.2 Example of packages  |   |               |
| <b>Unit V</b>   | <b>File Handling, Data Handling using Data Frames</b> | <b>6 Hrs.</b> |
| 5.1 Introduction to file<br>5.1.1 Definition<br>5.1.2 Types of files (Text, Binary and CSV file)<br>5.1.3 File Opening Modes (r, r+, w, w+, a, a+)<br>5.1.4 Creating files and Operations on files (open, close, read, write)<br>5.2 Data Manipulation<br>5.2.1 Creating Data Frame -User define, using csv file<br>5.2.2 View Data Frame<br>5.2.3 Preprocessing on Data Frame -Null Values, Duplicate values<br>5.2.4 Modify Data in Data Frame<br>5.2.5 Grouping and Aggregating Data<br>5.3 Data Visualization (Histogram, Line chart, Bar chart, Scatter plot )   |   |               |
| <b>Books</b>  |   |               |
| 1. Lubanovic Bill, "Introducing Python-Modern Computing in Simple Packages", 1 <sup>st</sup> Edition, O'Reilly Publication, 2014<br>2. Montojo, Jason., Campbell, Jennifer and Gries, Paul, "Practical Programming: An Introduction to Computer Science using Python 3", 2 <sup>nd</sup> Edition, O'Reilly, 2013<br>3. Dierbach Charles., "Introduction to Computer Science Using Python", 1 <sup>st</sup> Edition, Wiley Publication, 2015<br>4. Mueller, John P., "Beginning Programming with Python for Dummies", 1 <sup>st</sup> Edition, Dummies, 2014<br>5. A Beginner's Python Tutorial: <a href="http://en.wikibooks.org/wiki/ABeginner%27s">http://en.wikibooks.org/wiki/ABeginner%27s</a> |   |               |

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| <p align="center"><b>Savitribai Phule Pune University</b></p> <p align="center"><b>Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&amp;T or any faculty except FoS&amp;T for SEMESTER III only</b></p> <p align="center"><b>CA – 242 - MNP: Lab Course on CA – 241 - MN</b></p>   |   |  |
| <p><b>Teaching Scheme:</b><br/><b>Practical: 04 Hrs./ Week / Batch</b></p>   | <p><b>Credits</b><br/><b>02</b></p>                           | <p><b>Examination Scheme:</b><br/><b>Continuous Evaluation: 15 Marks</b><br/><b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce programming concepts using Python</li> <li>2. To understand various constructs in Python</li> <li>3. To test and execute Python programs.</li> </ol>   |   |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to:</p> <p><b>CO1:</b> Write Python programs to solve the given problem</p> <p><b>CO2:</b> Utilize the data structures such as lists, dictionaries, tuples and sets.</p> <p><b>CO3:</b> Use built-in and user defined modules and packages.</p> <p><b>CO4:</b> Apply operations involving file systems and data handling.</p> |   |  |
| <p align="center"><b>List of Assignments</b></p>   |   |  |
| <b>Unit 1</b>  | <b>Introduction to Python</b>                                 | <b>12 Hrs.</b>   |
| <p>Assignment on various operator in Python</p> <p>Assignment on Loop and decision control statement</p> <p>Assignment on classes and built in functions</p>   |   |  |
| <b>Unit 2</b>  | <b>Strings and Functions</b>                                  | <b>12 Hrs.</b>   |
| <p>Assignment on string operators and built-in string functions</p> <p>Assignment on user defined functions and math functions</p>   |   |  |
| <b>Unit 3</b>  | <b>Tuple, Set and Dictionary</b>                              | <b>12 Hrs.</b>   |
| <p>Assignment on Tuple</p> <p>Assignment on Sets</p> <p>Assignment on create dictionary</p> <p>Assignment on access and manipulates the elements from dictionary.</p>  |   |  |
| <b>Unit 4</b>  | <b>Modules and Packages</b>                                   | <b>12 Hrs.</b>   |
| <p>Assignment on importing, Creating and exploring modules</p> <p>Assignment on Math module, Random module, Time module, Regular expression module.</p> <p>Assignment on importing package and creating package</p>  |   |  |
| <b>Unit 5</b>  | <b>File Handling, Data Handling using (3) Data Frames (3)</b> | <b>12 Hrs.</b>   |
| <p>Assignment on Creating files and Operations on file</p> <p>Assignment on Data Frame creation and preprocessing on data</p> <p>Assignment on Data Visualization</p>  |   |  |

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| <p style="text-align: center;"><b>Savitribai Phule Pune University</b></p> <p style="text-align: center;"><b>Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&amp;T or any faculty except FoS&amp;T for SEMESTER IV only</b></p> <p style="text-align: center;"><b>CA - 291- MN: Introduction of Artificial Intelligence and Machine Learning</b></p>   |  |  |
| <p><b>Teaching Scheme:</b><br/><b>Theory: 02 Hrs./ Week</b></p>   | <p><b>Credits</b><br/><b>02</b></p>                              | <p><b>Examination Scheme:</b><br/><b>Continuous Evaluation: 15 Marks</b><br/><b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To learn the core concepts of AI, evolution and different paradigms of AI</li> <li>2. To understand expert systems and how they utilize knowledge bases and inference engines to solve problems.</li> <li>3. To study the concepts in machine learning, including supervised, unsupervised, and reinforcement learning.</li> <li>4. To know the basics of deep learning frameworks.</li> </ol>   |  |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to</p> <p><b>CO1:</b> Describe basic concepts in AI</p> <p><b>CO2:</b> Compare different search algorithms used in AI</p> <p><b>CO3:</b> Demonstrate understanding of knowledge representation and logic</p> <p><b>CO4:</b> apply key machine learning concepts such as supervised, unsupervised, and reinforcement learning.</p> <p><b>CO5:</b> Develop the ability to use machine learning algorithms such as linear regression, logistic regression, decision trees.</p>  |  |  |
| <p style="text-align: center;"><b>Course Contents</b></p>   |  |  |
| <b>Unit I</b>   | <b>Introduction to Artificial Intelligence and Problem Space</b> | <b>07 Hrs.</b>   |
| <ol style="list-style-type: none"> <li>1.1 Introduction</li> <li>1.2 Comparison of AI, Machine Learning, Deep Learning</li> <li>1.3 AI Techniques and Application of AI</li> <li>1.4 Agents               <ol style="list-style-type: none"> <li>1.4.1 definition and types of agents</li> <li>1.4.2 Agent and Environments</li> <li>1.4.3 Structure of Agents.</li> </ol> </li> <li>1.5 Defining problem as a State Space Search</li> <li>1.6 Production System, Problem Characteristics</li> <li>1.7 Problem Space               <ol style="list-style-type: none"> <li>1.7.1 Water Jug Problem</li> <li>1.7.2 Missionary Cannibal Problem</li> <li>1.7.3 Block Words Problem</li> <li>1.7.4 Monkey and Banana Problem</li> </ol> </li> </ol> |  |  |
| <b>Unit II</b>  | <b>Search Algorithms</b>   | <b>08 Hrs.</b>   |

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|-----------------|---|----------------|
| 2.1             | Search Algorithms   |                |
| 2.2             | Uninformed Search Algorithm / Blind Search Techniques   |                |
| 2.2.1           | Breadth-First Search  |                |
| 2.2.2           | Depth-First Search  |                |
| 2.3             | Informed Search Techniques  |                |
| 2.3.1           | Generate and Test   |                |
| 2.3.2           | Simple Hill Climbing  |                |
| 2.3.3           | Best First Search   |                |
| 2.3.4           | Constraint Satisfaction   |                |
| 2.3.5           | Mean End Analysis   |                |
| 2.3.6           | A* and AO*  |                |
| <b>Unit III</b> | <b>Knowledge Representation and Reasoning</b>   | <b>08 Hrs.</b> |
| 3.1             | Definition of Knowledge   |                |
| 3.2             | Types of Knowledge  |                |
| 3.2.1           | Procedural Knowledge  |                |
| 3.2.2           | Declarative Knowledge   |                |
| 3.3             | Approaches to Knowledge Representations   |                |
| 3.4             | Propositional and Predicate Logic   |                |
| <b>Unit IV</b>  | <b>Introduction to Machine Learning</b>   | <b>07 Hrs.</b> |
| 4.1             | Introduction to Machine Learning  |                |
| 4.2             | Key concept of Machine Learning (Data, Model, Training, Labels, Features)   |                |
| 4.3             | Types of Machine Learning (Supervised, Unsupervised and Reinforcement Learning)   |                |
| 4.4             | Deep Learning: Natural Language Processing, Computer Vision, Speech Recognition, Robotics, Generative AI.   |                |
| 4.5             | Applications  |                |
| <b>Books</b>    |   |                |
| 1.              | Norvig, Peter., and Russell, Stuart., "Artificial Intelligence: A Modern Approach", 3 <sup>rd</sup> Edition, Pearson, 2009  |                |
| 2.              | Knight, Kelvin. and Rich, Elaine., "Artificial Intelligence", 3 <sup>rd</sup> Edition, McGrawhill Publication, 2017   |                |
| 3.              | Geron, Aurelien., "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3 <sup>rd</sup> Edition, 2022   |                |
| 4.              | Goodfellow, Ian., Bengio, Yoshua and Courville, Aaron., "Deep Learning", MIT press, 2016  |                |
| 5.              | Muller, Andreas., "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1 <sup>st</sup> Edition, Shroff Publisher, 2016  |                |
| 6.              | Howard, Jeremy and Gugger, Sylvain, "Deep Learning for Coders with Fastai and PyTorch: AI Applications Without a PhD", O'Reilly, 2020   |                |
| 7.              | Raschka, Sebastian., Liu, Yuxi and Mirjalili, Vahid, "Machine Learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with Python", Packt Publication, 2022 |                |

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|---|---|--|
| <div>Savitribai Phule Pune University</div> <div>Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&amp;T or any faculty except FoS&amp;T for SEMESTER IV only</div> <div>CA – 292 – MNP: Lab Course on CA - 291 - MN</div>   |   |  |
| Teaching Scheme:<br>Practical: 04 Hrs./ Week/<br>Batch  | Credits<br>02                             | Examination Scheme:<br>Continuous Evaluation: 15 Marks<br>End-Semester: 35 Marks |
| <div>Course Objectives:</div> <div>1. To learn to use algorithms in AI and machine learning</div> <div>2. To understand various machine learning techniques, libraries and tools</div>  |   |  |
| <div>Course Outcomes:</div> <div>After successful completion of this course, the learners will be able to</div> <div>CO1: Apply the suitable AI algorithms to solve a given problem</div> <div>CO2: preprocess real-world data, including handling missing values, outliers, and scaling</div> <div>CO3: Use appropriate machine-learning libraries and tools</div> <div>CO4: solve problems using machine learning techniques.</div> |   |  |
| List of Assignments   |   |  |
| Assignment 1  | Artificial Intelligence and Problem Space |  |
| <div><div></div><div>Water Jug Problem</div><div>Missionary Cannibal Problem</div></div>  |   |  |
| Assignment 2  | Problem Space                             |  |
| <div><div></div><div>Block Words Problem</div><div>Monkey and Banana Problem</div></div>  |   |  |
| Assignment 3  | Search Algorithms                         |  |
| <div><div></div><div>Breadth-First Search</div><div>Depth-First Search</div></div>  |   |  |
| Assignment 4  | Search Algorithms                         |  |
| <div><div></div><div>Constraint Satisfaction</div></div>  |   |  |
| Assignment 5  | Generate and Test                         |  |
| <div><div></div><div>Simple Hill Climbing</div><div>Best First Search</div></div>   |   |  |
|   |   |  |
| Assignment 6  | Testing and Analysis                      |  |
| <div><div></div><div>Mean End Analysis</div><div>A* and AO*</div></div>   |   |  |
| Assignment 7  | Knowledge Representation                  |  |
| <div><div></div><div>Procedural Knowledge</div><div>Declarative Knowledge</div></div>   |   |  |

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| <b>Assignment 8</b>   | <b>Reasoning</b>                     |
| <ul style="list-style-type: none"> <li>• Propositional Logic</li> <li>• Predicate Logic</li> </ul>  |                                      |
| <b>Assignment 9</b>   | <b>Machine Learning Libraries</b>    |
| <ul style="list-style-type: none"> <li>• Scikit-learn, pandas, NumPy</li> <li>• Jupiter Notebook basics</li> <li>• Introduction to Google Collab</li> </ul> |                                      |
| <b>Assignment 10</b>  | <b>Data Cleaning</b>                 |
| <ul style="list-style-type: none"> <li>• User defined data frame creation</li> <li>• Missing data, noise removal</li> </ul>                                 |                                      |
| <b>Assignment 11</b>  | <b>Data Visualization Techniques</b> |
| <ul style="list-style-type: none"> <li>• Data visualization techniques using Matplotlib and Seaborn</li> </ul>  |                                      |
| <b>Assignment 12</b>  | <b>GenAI</b>                         |
| <ul style="list-style-type: none"> <li>• Use GenAI to acquire the knowledge in structured format like if then else rule.</li> </ul>                         |                                      |



Detailed Drafts Of  
Open Elective Courses offered  
by BOS (Computer Applications)  
to  
any faculty except FoS&T  
for  
SEMESTER III and IV only

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| <p style="text-align: center;"><b>Savitribai Phule Pune University</b><br/> <b>Open Elective course offered by BOS (Computer Applications) to any faculty except FoS&amp;T for SEMESTER III only</b><br/> <b>OE – 201 – CA: Introduction to Artificial Intelligence</b></p>  |  |  |
| <p><b>Teaching Scheme:</b><br/> <b>Theory: 02 Hrs./ Week</b></p>   | <p><b>Credits</b><br/> <b>02</b></p>           | <p><b>Examination Scheme:</b><br/> <b>Continuous Evaluation: 15 Marks</b><br/> <b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To learn the core concepts of AI, evolution and different paradigms of AI</li> <li>2. To understand expert systems and how they utilize knowledge bases and inference engines to solve problems.</li> <li>3. To study the concepts in machine learning, including supervised, unsupervised, and reinforcement learning.</li> <li>4. To know the basics of deep learning frameworks</li> </ol> |  |  |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to</p> <p><b>CO1:</b> Describe basic concepts in AI</p> <p><b>CO2:</b> Compare different search algorithms used in AI</p> <p><b>CO3:</b> Demonstrate understanding of knowledge representation and logic</p> <p><b>CO4:</b> Compare supervised, unsupervised, and reinforcement learning.</p>   |  |  |
| <p style="text-align: center;"><b>Course Contents</b></p>  |  |  |
| <b>Unit I</b>  | <b>Introduction to Artificial Intelligence</b> | <b>04 Hrs.</b>   |
| <ol style="list-style-type: none"> <li>1.1 Introduction</li> <li>1.2 Comparison of AI, Machine Learning, Deep Learning</li> <li>1.3 Applications of AI</li> <li>1.4 AI Techniques</li> <li>1.5 Agents and Types of Agents, Agents and Environments, Structure of Agents</li> </ol>   |  |  |
| <b>Unit II</b>   | <b>Problems, Problem Spaces and search</b>     | <b>04 Hrs.</b>   |
| <ol style="list-style-type: none"> <li>2.1 Defining problem as a State Space Search</li> <li>2.2 Production System</li> <li>2.3 Problem Characteristics</li> <li>2.4 Search and Control Strategies</li> <li>2.5 Problems- Water Jug problem, Missionary Cannibal Problem, Block words Problem, Monkey and Banana problem</li> </ol>  |  |  |

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| <b>Unit III</b>   | <b>Knowledge Representation and Introduction to Searching Algorithms</b> | <b>12 Hrs.</b> |
| 3.1 Knowledge Representation<br>3.1.1 Introduction<br>3.1.2 Types of knowledge<br>3.1.3 Approaches to Knowledge Representation<br>3.1.4 Applications of Knowledge Representation<br>3.2 Search Algorithm<br>3.2.1 Elements of AI search algorithms<br>3.2.2 Importance of Search Algorithm<br>3.2.3 Types of AI search algorithms (BFS, DFS, A* and AO*)<br>3.2.4 Applications  |  |                |
| <b>Unit IV</b>  | <b>Machine Learning</b>  | <b>10 Hrs.</b> |
| 4.1 Introduction to Machine Learning<br>4.2 Key concept of Machine Learning (Data, Model, Training, Labels, Features)<br>4.3 Types of Machine Learning (Supervised, Unsupervised and Reinforcement Learning)<br>4.4 Deep Learning: Natural Language Processing, Computer Vision, Speech Recognition, Robotics, Generative AI.<br>4.5 Applications   |  |                |
| <b>Books</b>  |  |                |
| 1. Knight, Kelvin. and Rich, Elaine., "Artificial Intelligence", 3 <sup>rd</sup> Edition, Mc-Graw Hill Publication, 2017<br>2. Ertel, Wolfgang and Black Nathanael T., "Introduction to Artificial Intelligence", Springer, 2011<br>3. Mitchell, Tom M., "Machine Learning", McGraw Hill, 1997<br>4. Nilsson Nils J., "Artificial Intelligence: A New Synthesis", Morgan Kaufman, 1998<br>5. Ethem, Alpaydin., "Introduction to Machine Learning", 3 <sup>rd</sup> Edition, PHI Publication, 2015 |  |                |

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|---|--|---|
| <p align="center"><b>Savitribai Phule Pune University</b></p> <p align="center"><b>Open Elective course offered by BOS (Computer Applications) to any faculty except FoS&amp;T for SEMESTER IV only</b></p> <p align="center"><b>OE – 251 – CA: Software Tools for Office Administration</b></p>  |  |   |
| <p align="center"><b>Teaching Scheme:</b><br/><b>Practical: 04 Hrs./Week/ Batch</b></p>   | <p align="center"><b>Credits</b><br/><b>02</b></p> | <p align="center"><b>Examination Scheme:</b><br/><b>Continuous Evaluation:15Marks</b><br/><b>End-Semester: 35 Marks</b></p> |
| <p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To be familiarize with office automation tools for efficient document management, data processing, and communication.</li> <li>2. To understand tools for word processing, spreadsheets, presentations, and data collection to enhance office productivity.</li> <li>3. To study tools for collaboration and management of files using cloud-based platforms like Google Drive and OneDrive securely.</li> <li>4. To learn email etiquette, calendar scheduling, and cyber security for professional office administration.</li> </ol>   |  |   |
| <p><b>Course Outcomes:</b> After successful completion of this course, the learners will be able to</p> <p><b>CO1:</b> Apply word processing techniques to create, format, and manage professional documents</p> <p><b>CO2:</b> Use spreadsheet tools for data entry, analysis, visualization, and decision-making.</p> <p><b>CO3:</b> Design and deliver interactive professional presentations using animations and multimedia integration.</p> <p><b>CO4:</b> Create and analyze Google Forms for data collection, surveys, and automated feedback management.</p> <p><b>CO5:</b> Implement email and cloud-based collaboration tools to enhance office communication, scheduling, and document security.</p>  |  |   |
| <p align="center"><b>List of Assignments</b></p>  |  |   |
| <p align="center"><b>Document Creation and Communication Tools</b></p>  |  | <b>15 Hrs.</b>  |
| <p><b>Assignment 1: Understanding CV Formatting and Design:</b> Create a Curriculum Vitae (CV) using Google Docs or MS Word. Apply proper formatting with headings, bold text, and bullet points. Upload the document to Google Drive and share it with your friends as viewers.</p> <p><b>Assignment 2: Automating Personalized Communication with Mail Merge:</b> Use Mail Merge in MS Word to send personalized invitation letters. Prepare an Excel sheet with at least 5 names and email addresses. Merge the data into a formal letter template. Save the final document as PDF, upload it to Google Drive</p> <p><b>Assignment 3: Writing Formal Emails for Professional Communication:</b> Compose a formal email to your professor requesting a meeting using Gmail or Outlook. Attach a Word file as an agenda.</p> |  |   |

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| <b>Spreadsheets for Data Management and Analysis</b>  | <b>15 Hrs.</b> |
| <p><b>Assignment 4: Data Visualization Using Charts and Conditional Formatting</b><br/> Analyze sales data using charts in MS Excel or Google Sheets. Enter sample sales data (Product, Sales, Revenue, etc.). Create a Bar Chart and Pie Chart to visualize the data. Apply conditional formatting to highlight low sales.</p> <p><b>Assignment 5: Financial Tracking with Google Sheets</b><br/> Create a monthly expense tracker in Google Sheets. Include columns: Date, Category, Amount, and Total. Use the SUM formula to calculate total expenses. Format the sheet properly.</p>   |                |
| <b>Presentations and Multimedia Integration</b>   | <b>15 Hrs.</b> |
| <p><b>Assignment 6: Enhancing Presentations with Multimedia and Effects</b><br/> Design a 5-slide presentation on "Future of Office Automation" using Google Slides or MS PowerPoint. Include images, animations, and transitions. Add a video or audio clip to enhance the content.</p>  |                |
| <b>Online Collaboration and Cloud-Based Tools</b>   | <b>15 Hrs.</b> |
| <p><b>Assignment 7: Creating and Analyzing Surveys Using Google Forms</b><br/> Create a Google Form to collect event feedback. Include multiple-choice, rating scale, and short-answer questions. Collect at least 10 responses and analyze them in Google Sheets.</p> <p><b>Assignment 8: Efficient Meeting Scheduling with Google Calendar</b><br/> Schedule a team meeting using Google Calendar. Add title, date, time, and agenda. Invite at least 3 participants and set a reminder.</p> <p><b>Assignment 9: File Management and Collaboration in Google Drive</b><br/> Organize and share files in Google Drive. Create a folder named "Office Automation Project" and upload at least 3 different files (Doc, Sheet, Slide)</p> |                |
| <b>Books</b>  |                |
| <ol style="list-style-type: none"> <li>1. Randy, Nordell, "Microsoft Office 365: In Practice", 1<sup>st</sup> Edition, McGraw-Hill Publication, 2023</li> <li>2. Steve Tudor, "Excel 2023: The Most Updated Guide to Master Microsoft Excel"</li> <li>3. Richard Wilson, "Google Forms and Google Sheets for Beginners"</li> <li>4. Poatsy, Mary Anne., and Davidson, Jason, "Microsoft Word 2021 and 365 for Beginners", 1<sup>st</sup> Edition, Pearson Publication, 2022</li> </ol>  |                |

# Abbreviations

|         |  |
|---------|--|
| AEC     | Ability Enhancement Course   |
| CEP     | Community Engagement Project   |
| FoS&T   | Faculty of Science and Technology  |
| FP      | Field Project  |
| GE / OE | General / Open Elective Course   |
| IKS     | Indian Knowledge System  |
| MJ      | Major Core Theory Course   |
| MJP     | Major Core Laboratory Course   |
| MN      | Multidisciplinary Minor Theory Course  |
| MNP     | Multidisciplinary Minor Laboratory Course  |
| MOOC    | Massive Open Online Course   |
| NEP     | National Educational Policy - 2020   |
| NPTEL   | National Programme on Technology Enhanced Learning                                     |
| SEC     | Skill enhancement Course   |
| SPPU    | Savitribai Phule Pune University   |
| SWAYAM  | Study Webs of Active-Learning for Young Aspiring Minds VEC      Value Education Course |
| VEC     | Value Education Course   |
| VSC     | Vocational Skill Enhancement Course  |

# Savitribai Phule Pune University, Pune

Maharashtra, India



## Task Force for Curriculum Design and Development Of SY Bachelor of Computer Applications

**Programme Coordinator**

**Dr. A B Nimbalkar - Member, Ad-hoc Board of Studies -  
Computer Applications**

**Team Members for Course Design**

| Data Structures       |   |
|-----------------------|---|
| Name of the Faculty   | Name of the College   |
| Dr. Patil Rahul       | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik   |
| Mrs. Borase S P       | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik   |
| Mrs. Ghorpade S J     | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik   |
| Mrs. Jyoti P Malusare | Haribhai V. Desai College of Arts, Science and Commerce, Pune |
| Mrs. Shivarkar Sonali | S. M. Joshi College, Hadapsar, Pune                           |

| C++ Programming          |   |
|--------------------------|---|
| Name of the Faculty      | Name of the College   |
| Mrs. Kadam S. A.         | Baburaoji Gholap College, Sangvi, Pune                              |
| Mrs. Suvarna S Patil     | BJS ASC College, Wagholi, Pune                                      |
| Dr. Preeti Bharambe      | MAEERs MIT Arts Commerce and Science College Alandi, Pune           |
| Mrs. Sarita Somnath Raut | Pravara medical trust's Arts commerce and science college, Shevgaon |

| Programming with Python |  |
|-------------------------|--|
| Name of the Faculty     | Name of the College  |
| Mrs. Dipali Meher       | PES Modern College of Arts Science and commerce, Ganeshkhind, Pune |
| Mrs. Chandgude Vidya    | MIT Arts Commerce & Science College, Alandi, Pune                  |
| Mrs. Saykar Sunita J.   | Annasaheb Magar College, Pune                                      |
| Mrs. Kamble Jayshree    | Pratibha college of commerce and computer studies, Pune            |
| Mr. Derle D R           | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik        |

| Introduction to Artificial Intelligence |   |
|---|---|
| Name of the Faculty                     | Name of the College   |
| Mrs. Rohini Subhash Kapse               | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik |
| Mrs. Sonali Sagar Gholve                | Sarhad College of ACS, Katraj, Pune                         |
| Mrs. Suvarna Sachin Pardeshi            | Ahmednagar College, Ahilyanagar                             |

| Indian Knowledge System for Computing |   |
|---------------------------------------|---|
| Name of the Faculty                   | Name of the College                                       |
| Dr. Vikas Nana Mahandule              | MAEERs MIT Arts Commerce and Science College Alandi, Pune |
| Mrs. Chavan Rutuja                    | Pratibha College of Commerce and Computer Studies, Pune   |

| Database Management Systems   |   |
|-------------------------------|---|
| Name of the Faculty           | Name of the College                                     |
| Dr. Reena Shinde              | Sinhgad College of Science, Pune                        |
| Mrs. Kadlag Vinita            | Annasaheb Magar College, Pune                           |
| Mrs. Vrunda P Chouthkanthiwar | JSPM'S JSIMR, Pune                                      |
| Mrs. Gogte Suvarna            | Pratibha College of Commerce and Computer Studies, Pune |

| Python Programming       |  |
|--------------------------|--|
| Name of the Faculty      | Name of the College  |
| Dr. Sanjay T Wani        | Women's College of Home Science and BCA, Loni                  |
| Mrs. Dipali Deepak Mali  | Annasaheb Magar Mahavidyalaya, Pune                            |
| Mrs. Dhadaawe Priya Amit | Sarhad college of Arts, Commerce and Science, Katraj Pune      |
| Mrs. Alka Baban Mhetre   | RJSP Mandal's Arts commerce and science college, Bhosari, Pune |

| Introduction to Artificial Intelligence and Machine Learning |   |
|--|---|
| Name of the Faculty  | Name of the College   |
| Dr Harshita Vachhani   | Pratibha college of Commerce and Computer Studies, Pune     |
| Mr. Sanjay S Manvatkar                                       | BJS ASC College, Wagholi, Pune                              |
| Ms. Gadekar Manisha J  | Annasaheb Magar College, Pune                               |
| Mrs. More K D  | KRT Arts, BH Commerce and AM Science College (KTHM), Nashik |

| Software Tools for Office Administration |   |
|--|---|
| Name of the Faculty                      | Name of the College                                       |
| Dr. Vikas Nana Mahandule                 | MAEERs MIT Arts Commerce and Science College Alandi, Pune |
| Prof. More R.N.                          | Annasaheb Magar College, Pune                             |
| Mr. Amit Vilasrao Tale                   | MAEERs MIT Arts Commerce and Science College Alandi, Pune |



| <b>Spreadsheet Applications</b> |   |
|---------------------------------|---|
| <b>Name of the Faculty</b>      | <b>Name of the College</b>                          |
| Mrs. Savita Bhujbal             | Annasaheb Magar Mahavidyalaya Hadapsar, Pune        |
| Mrs. Vijayshri Bava (Gosavi)    | K. K. Wagh Arts, Commerce & Science College, Nashik |

| <b>Members of Ad-hoc Board of Studies - Computer Applications</b> |   |
|---|---|
| <b>Name</b>   | <b>Affiliation</b>                                    |
| Dr. S S Sane  | R H Sapat COE, Management Studies and Research Nashik |
| Dr. A B Nimbalkar   | Annasaheb Magar Mahavidyalaya Hadapsar, Pune          |
| Dr. Razzak Sayyad   | Ahmednagar College, AhilyaNagar                       |
| Dr. R M Sonar   | IIT, Powai, Mumbai                                    |
| Dr. S A Kadam   | Bharati Vidyapeeth, Pune                              |

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