Faculty of Science and Technology

Savitribai Phule Pune University, Pune

NEP – 2020 Complaint Curriculum

Draft copy of Syllabus
for
S.Y. B. Sc. (Computer Applications)
(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.

21st 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, tstarted 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), 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 B. Sc. (CA) was implemented from June 2024. This document provides detailed draft for SY B. Sc. (CA) which will be implemented from June 2025.

The Ad-hoc Board of Studies in Computer Applications has prepared a structure for Bachelor of Science (Computer Applications) 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 B. Sc. (CA).

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.

Table of Contents

Structure of SY B. Sc. (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	**100**	04	--	--	**04**
CA-202-MJP		Lab course on CA-201 -MJ	--	--	04	15	35	**50**	--	--	02	**02**
CA-221 -VSC	VSC	C++ Programming	--	--	04	15	35	**50**	--	--	02	**02**
CA-231-FP	FP	Field Work	--	--	04	15	35	**50**	--	--	02	**02**
ELS-241-MN	MN	Data Communications	02	--	--	15	35	**50**	02	--	--	**02**
ELS-242-MNP		Lab Course on CA -241 –MN	--	--	04	15	35	**50**	--	--	02	**02**
	GE/OE	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
CA-200 -IKS	IKS	Indian Knowledge System for Computing	02	--	--	15	35	**50**	02	--	--	**02**
	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
	CC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
Total			**14**	**00**	**16**	**165**	**385**	**550**	**14**	**00**	**08**	**22**

Structure of SY B. Sc. (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	**100**	04	--	--	**04**
CA-252-MJP		Lab course on CA-251 –MJ	--	--	04	15	35	**50**	--	--	02	**02**
CA-271-VSC	VSC	Python Programming	--	--	04	15	35	**50**	--	--	02	**02**
CA-281 CEP	CEP	Community Services	--	--	04	15	35	**50**	--	--	02	**02**
ELS-291 - MN	MN	Communication Networks	02	--	--	15	35	**50**	02	--	--	**02**
ELS-292 - MNP		Lab course on CA -291 –MN	--	--	04	15	35	**50**	--	--	02	**02**
	GE/OE	Course from University Basket	--	--	04	15	35	**50**	--	--	02	**02**
SEC-251-CA	SEC	Spreadsheet Applications	--	--	04	15	35	**50**	--	--	02	**02**
	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
	CC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
Total			**10**	**00**	**24**	**165**	**385**	**550**	**10**	**00**	**12**	**22**

Exit option: Award of UG Diploma in B. Sc. (Computer Application) 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 B. Sc. (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		
Unit I	**Introduction to Data Structure**	**10 Hrs.**
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 (Ω) (With examples)	
Unit II	**Arrays**	**10 Hrs.**
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	
Unit III	**Linked Lists**	**10 Hrs.**
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,	

Concatenation, Merge

3.5 Real world applications of Link list : Polynomial Representation, Addition of two polynomials

Unit IV	Stacks and Queues	10 Hrs.

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)

Unit V	Trees	10 Hrs.

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)

Unit VI	Graphs	10 Hrs.

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”,1st Edition, Galgotia,1984
2. Kamthane, Ashok N., “Introduction to Data Structures using C”,1st Edition, Pearson,2004
3. Bandopadhya, S. K. and Dey, K. S. “Data Structures using C”, 1st Edition, Pearson, 2004
4. Srivastava, S. K. and Srivastava, D., “Data Structures using C”,1st Edition, BPB Publication, 2004
5. Gilberg, Richard F. and Forouzan, Behrouz A., “Data Structures: A Pseudocode approach with C”, 2nd Edition, Cengage Learning, 2007
6. Steven S. S, “The Algorithm Design Manual”, 2nd Edition, Springer, 2008

Savitribai Phule Pune University
Second Year B. Sc. (Computer Applications)
CA - 202 - MJP: Lab course on CA – 201 - MJ

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

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 • Bubble Sort • Insertion Sort	4
2	Recursive Sorting Techniques • Quick Sort • Merge Sort	6
3	Searching Techniques • Linear search • Binary search	2
4	Linked List • Implementation of Linked List, Singly Circular Linked List, Doubly Linked List, Doubly Circular Linked List, operations	12
5	Stacks and Queues • Static Stack Implementation and operations • Dynamic Stack Implementation • Applications of Stack -Expression Conversions • Static Queue Implementation and operations • Dynamic Queue Implementation	12
6	Binary Trees and Binary Search Tree (Dynamic) • Operations on Binary trees – Traversing, level wise printing of nodes, counting total nodes, compute depth, Insert, Delete and search node • BST-create, traverse, count total nodes, Insert, Delete and search node	12
7	Graphs • Adjacency Matrix Representation • Adjacency List Representation • In-degree and Out-degree calculation • BFS, DFS Implementation	12

Savitribai Phule Pune University
Second Year B.Sc. (Computer Applications)
CA - 221 - VSC: C++ Programing

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./week/ batch	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To understand Object Oriented Programming concepts using the C++
2. To study principles of data abstraction, inheritance and polymorphism.
3. To learn Virtual functions and polymorphism.
4. To know Formatted I/O and unformatted I/O.

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

CO1: Compare the procedural and object-oriented paradigms

CO2: Use Classes, Objects, constructors, destructors etc.

CO3: Illustrate the concept of function overloading, operator overloading, inheritance, virtual functions and polymorphism.

CO4: Apply exception handling

CO5: Demonstrate use of various OOPs concepts with the help of programs

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 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.

List of Assignments

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.

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

Savitribai Phule Pune University
Second Year B.Sc. (Computer Applications)
CA - 231 - FP: Field work

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./ Week	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To provide exposure to the students and sensitize them to field issues/problems
2. To understand methodology used to perform field work

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

CO1: Apply methodology to perform field work

CO2: Identify and define real-world issues or problems

CO3: Analyze the data collected and propose solution to solve real-world problem

Guidelines for the faculty

A faculty shall be assigned as a guide for each group of 3 / 4 students.
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
The guide assigned for each group shall monitor, track and assess the progress of work carried out by students throughout the semester

Guidelines for Students

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.

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.

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.

The suggested timelines for the field work are

- Formation of group – 1 week
- Selection of topic for field study – 2 Week
- Discussions and finalization of objectives, outcomes and methodology to be used – 3 Weeks
- Field work and visits, SWOT/SWOC analysis, group discussions and meeting with guide – Conduction of survey / gathering data etc. – 4 Weeks
- Preparation of report and presentation – 2 weeks

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.

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
Second Year Bachelor of Computer Applications
CA – 200 – IKS: Indian Knowledge System for Computing

Teaching Scheme:	Credits	Examination Scheme:
Theory: 02 Hrs./Week	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To study contributions of Indian scholars to computation and logic.
2. To understand Indian methods for Number representations
3. To know use of Sanskrit in Natural language processing
4. To learn ancient cryptography techniques

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

CO1: List India's contributions to Computing
CO2: Apply Ancient Indian Mathematical concepts in Computing
CO3: Utilize Linguistic and Computational aspects of Sanskrit from IKS in Modern Computing
CO4: Describe Cryptographic techniques from IKS
CO5: Make use of Cybersecurity techniques from IKS
CO6: Illustrate the Role of IKS in Emerging Technologies

Course Contents

Unit I	Introduction to Indian Knowledge Systems (IKS)	05Hrs.

1.1 Introduction IKS
1.2 Defining Indian Knowledge System (IKS) and its components,
1.3 Contribution of Aryabhata and Brahmagupta, Buddhist logico-epistemology
1.4 The knowledge triangle
1.5 Prameya -A vaiśeṣikan approach to physical reality
1.6 Dravyas -the constituents of the physical reality
1.7 Attributes -the properties of substances and Action -the driver of conjunction and disjunction
1.8 sāmānya, viśēṣa, samavāya
1.9 Pramāṇa -the means of valid knowledge
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
2.2 Salient Features of the Indian Numeral System
  2.2.1 Concept of zero and its importance,
  2.2.2 Large numbers and their representation
  2.2.3 Place Value of Numerals
  2.2.4 Decimal System
2.3 Unique approaches to represent Numbers
  2.3.1 Bhūta-Saṃkhyā system

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

Detailed Drafts

For

Level 5.0 (SY)

SEMESTER IV

Savitribai Phule Pune University
Second Year Bachelor of Computer Applications
CA - 251- MJ: Database Management Systems

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs./Week	04	Continuous Evaluation: 30 Marks End-Semester: 70 Marks

Course Objectives:

1. To understand the fundamental concepts of Relational database management systems
2. To study and understand systematic approaches for design of database systems
3. To learn SQL - the database Query language
4. To know about transaction management and data security

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

CO1: Solve real world problems using appropriate relational data model.
CO2: Construct E-R Model for given requirements and convert it into database tables.
CO3: Write efficient SQL queries and use PL/SQL
CO4: Apply database management operations
CO5: Describe mechanisms for transaction management
CO6: Demonstrate understanding of database security

Unit I	Introduction	06 Hrs.

1.1 Introduction to DBMS
1.2 File system Vs. DBMS
1.3 Data models -relational, hierarchical, network
1.4 Levels of abstraction
1.5 Data independence
1.6 Structure of DBMS
1.7 Users of DBMS
1.8 Advantages and disadvantages of DBMS

Unit II	Conceptual and Relational Database Design	12 Hrs.

2.1 Overview of DB design process.
2.2 Introduction to data models (E-R model, Relational model, Network model, Hierarchical model)
2.3 Conceptual design using ER data model (entities, attributes, entity sets, relations, relationship sets) and symbols. Extended ER Features, ER to Relational Mapping
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)
2.5 Keys in Database (primary key, foreign key, Candidate key, super key)
2.6 Extended features - Specialization, Aggregation, Generalization (Pictorial representation).
2.7 Structure of Relational Databases (concepts of a table)

2.8	Concept of Normalization -Normal forms (only definitions) with example (1NF,2NF,3N, 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)

Unit III	**Structured Query Language (SQL)**	**10 Hrs.**

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)

Unit III	**Structured Query Language (SQL)**	**10 Hrs.**

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)

Unit IV	**Introduction to PL/Postgres SQL**	**12 Hrs.**

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

Unit V	**Transaction Management**	**12 Hrs.**

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

5.3 Concept of serializability

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

Unit VI	**Database Security**	**8 Hrs.**

6.1 Introduction to database security concepts

6.2 Methods for database security

6.3 Access Control Method

6.3.1 Discretionary access control method

6.3.2 Mandatory access control

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.

Books

1. Silberschatz, Korth, and Sudarshan, “Database System Concepts”, 6th Edition, McGraw-Hill, 2011
2. Elmasri and Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson, 2017
3. Ramakrishnan and Gerkhe,“Database Management Systems”, 3rd Edition, Tata McGraw Hill, 2002
4. Desai Bipin, “Introduction to Database Management System”, 1st Edition, Galgotia Publication, 2008
5. Date, C. J., Kannan and Swamynathan,“An Introduction to Database Systems”, 8th Edition, Pearson, 2006
6. Drake and Worsley, “Practical PostgreSQL”, O’Reilly Publications, 2002
7. Kahate, “Introduction to Database Management Systems”, 1st Edition, Pearson Education, 2004
8. Singh, S. K., “Database Systems: Concepts, Design and Application”, 2nd Edition, Pearson, 2011

Savitribai Phule Pune University
Second Year Bachelor of Computer Applications
CA – 252 - MJP: Lab course on CA - 251 - MJ

Teaching Scheme	Credits	Examination Scheme:
Lab: 04 Hrs./ Week/ Batch	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To study DDL and DML Queries
2. To understand SQL and PL/SQL

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

CO1: Design E-R Model for given requirements and convert the same into database tables.

CO2: Design and create relational database systems.

CO3: Use SQL DDL and DML commands

CO4: Apply constructs in PL/PGSQL

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 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 the practical examination to judge understanding of concepts by the students.

List of Assignments

Assignment No 1	Simple table design (DDL) Commands	4 Hrs.

Create simple tables including all data types.

- Primary key constraint (as a table level constraint and as a column level constraint)
- Check constraint (All types)
- Unique constraint, Null/Not null constraint

Assignment No 2	**Simple tables using referential constraint (DDL) commands**	**4 Hrs.**
• Create more than one table and access them using referential integrity constraint.		
Assignment No 3	**DDL commands**	**4 Hrs.**
• Drop a table, Alter schema of a table. • Insert / Update / Delete records using tables created in previous Assignments		
Assignment No 4	**DML commands**	**8 Hrs.**
• Write queries on the tables using SQL select query ➢ Select <field-list> from table [where <condition> order by <field list>], Select <field-list, aggregate functions> from table [where <condition> group by <> having <> order by <>] • To create views and retrieve data using the views		
Assignment No 5	**DML commands**	**4 Hrs.**
• Write queries using set operations (minus operation, union, union all, intersect, intersect all)		
Assignment No 6	**Nested Queries**	**4 Hrs.**
• Write nested queries using Except, Except all, Exists, Not exists etc.		
Assignment No 7	**Stored Procedure**	**6 Hrs.**
• Create a Simple Stored Procedure • Create a Stored Procedure with IN, OUT and IN/OUT parameter		
Assignment No 8	**Function**	**6 Hrs.**
• Create and use a Simple Stored Function • Create and use a simple Stored Function that returns • Create and use a simple Stored recursive Function		
Assignment No 9	**Cursor**	**4 Hrs.**
• Create and use a Simple Cursor • Create and use a Parameterized Cursor		
Assignment No 11	**Exception Handling**	**4 Hrs.**
• Create and use a Simple Exception-Raise Debug Level Messages • Create and use a Simple Exception-Raise Notice Level Messages • Create and use a Simple Exception-Raise Exception Level Messages		
Assignment No 12	**Triggers**	**10 Hrs.**
• Create and perform insert, update, delete using a Before Trigger & an After Trigger • Creating EER Diagram and schemas using MySQL- Workbench or any such tools • Store data in simple DBMS and retrieve it in spreadsheets using SQL query		

Savitribai Phule Pune University
Second Year Bachelor of Computer Applications
CA – 271 - VSC: Python Programming

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

Course Objectives:

1. To introduce programming concepts using Python
2. To understand various constructs in Python
3. To test and execute Python programs.

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

CO1: Write Python programs to solve a given problem

CO2: Choose appropriate data structures such as lists, dictionaries, tuples, and sets.

CO3: Develop Python programs to implement the given small applications.

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 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.

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
Total		**60**

BOOKS

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

Savitribai Phule Pune University
Second Year B.Sc. (Computer Applications)
CA – 271 - CEP: Community services

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./ Week	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To provide exposure to the students and sensitize them for community issues/problems
2. To know levels of community engagements (Informative, participative and decision-making participations)

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

CO1: Identify and define community engagement service to address community problem

CO2: Choose appropriate community engagement level to solve the problem

CO3: Analyze and propose possible solution to solve community problem

Guidelines for the faculty

A faculty shall be assigned as a guide for each group of 3 / 4 students.
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

Guidelines for Students

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.

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.

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.

The suggested timelines for the field work are

- Formation of group – 1 week
- Selection of topic for community engagement – 2 Week
- Discussions and finalization of objectives, outcomes and methodology to be used – 3 Weeks
- Activities for community engagement - Conduction of survey / gathering data, Awareness programs, interviews, group discussions and meeting with guide — 4 Weeks
- Preparation of report and presentation – 2 weeks

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.

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

Savitribai Phule Pune University
Second Year Bachelor of Computer Applications
CA – 251 - SEC: Spreadsheet Applications

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

Course Objectives:

1. To know Excel interface, basic and advanced Data Entry and Formatting
2. To understand Excel Formulas and Functions, Charts
3. To learn to automate tasks with Macros and VBA

Course Outcomes:

After successful completion of this course, the learners will be able to -

CO1: Navigate and utilize spreadsheet applications effectively for data organization and management

CO2: Apply formulas, functions and logical operations to automate tasks.

CO3: Analyze and visualize data using charts, pivot tables and conditional formatting

CO4: Implement data validation, sorting and filtering for efficient data handling

CO5: Develop practical spreadsheet solutions for business scenarios like financial planning, inventory management and project management.

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 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.

List of Assignments

1. Create, Open, Save Spreadsheet, Basic Data Entry and Formatting and conditional formatting, Formula and function, Sorting, importing data from various formats (csv/text)

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”, 2nd Edition, John Wiley & Sons, 2022
2. Mc, Fedries and Greg Harvey, “Excel All-in-One for Dummies”, 1st 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

Savitribai Phule Pune University

Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&T or any faculty except FoS&T for SEMESTER III only

CA – 241 – MN: Programming with Python

Teaching Scheme: Theory: 02 Hrs./ Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To introduce programming concepts using Python
2. To understand various constructs in Python
3. To test and execute Python programs.

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

CO1: Write Python programs to solve the given problem

CO2: Utilize the data structures such as lists, dictionaries, tuples and sets.

CO3: Use built-in and user defined modules and packages.

CO4: Apply operations involving file systems and data handling.

Course Contents

Unit I	Introduction to Python	5 Hrs.

1.1 Introduction
- 1.1.1. Python identifiers and reserved words
- 1.1.2. Lines and indentation, multi-line statements and Comments
- 1.1.3. Input/output with print and input functions
- 1.1.4. Command line arguments and processing command linear augments

1.2 Data Types
- 1.2.1 Standard data types -basic, none, Boolean, numbers
- 1.2.2. Data type conversion

1.3 Operators
- 1.3.1: Basic operators (Arithmetic, comparison, assignment, bitwise, logical)
- 1.3.2 Membership operators (in, not in)
- 1.3.3. Identity operators (is, is not)

1.4 Control Statement
- 1.4.1 Conditional/decision statements (if, if—else, elif,
- 1.4.2. Loop Control Structure (while, Do--while, for)
- 1.4.3 Selection Control Statement (Switch case, Pass, Continue, Break)

1.5 Basic Object-Oriented Programming Concepts in Python
- 1.5.1 Creating classes, instance, objects, accessing members
- 1.5.2 Data hiding (the double underscore prefix)
- 1.5.3 Built-in class attributes

1.5.4 Garbage collection

1.5.5 Constructor

1.6 Applications of Python

Unit II	Functions and Strings	7 Hrs.

2.1 Introduction to function

2.1.1 Defining a function, calling a function

2.1.2 Types of function (Built-in, function, user-defined function, lambda function /anonymous function, recursive function)

2.1.3 Function arguments

2.1.4 Global and Local variable, Examples

2.1.5 Math Functions

2.1.6 Functional programming tools -filter( ), map( ), and reduce( )

2.2 Introduction to string

2.2.1 Declaration and String manipulation -Accessing String, String Slices.

2.2.2 Documentation Strings-Single quotes, Double quotes, Triple quotes, Raw String

2.2.3 Python string operators, escape character

2.2.4 String formatting operator

2.2.5 Built-in String functions / Methods

Unit III	Tuple, Set and Dictionary	8 Hrs.

3.1 Introduction to tuple

3.1.1 Tuple definition, accessing tuple values, update and delete tuple elements

3.1.2 Basic Tuple operations

3.1.3 Tuple -Indexing and slicing

3.1.4 Built in tuple functions

3.1.5 Applications of tuple

3.2 Introduction to set

3.2.1 Create, update and remove elements from set

3.2.2 Set operations

3.2.3 Set built-in functions

3.2.4 Applications of set

3.3 Introduction to Dictionary

3.3.1 Creating and accessing values in a dictionary

3.3.2 Updating dictionary, delete dictionary elements

3.3.3 Properties of dictionary keys

3.3.4 Built-in dictionary functions and methods

Unit IV	Modules and Packages	4 Hrs.

4.1 Introduction to Module

4.2 Types of Module and Examples

4.2.1 Built_in Module (Math module, Random module, Time module, regular expression)

	4.2.2 User Defined Module (creation and import)	
	4.2.3 External Module (Python libraries-NumPy, Pandas, Matplotlib, Seaborn)	
4.3	Introduction to Package	
	4.3.1 Importing and creating package	
	4.3.2 Example of packages	
Unit V	**File Handling, Data Handling using Data Frames**	**6 Hrs.**
5.1	Introduction to file	
	5.1.1 Definition	
	5.1.2 Types of files (Text, Binary and CSV file)	
	5.1.3 File Opening Modes (r, r+, w, w+, a, a+)	
	5.1.4 Creating files and Operations on files (open, close, read, write)	
5.2	Data Manipulation	
	5.2.1 Creating Data Frame -User define, using csv file	
	5.2.2 View Data Frame	
	5.2.3 Preprocessing on Data Frame -Null Values, Duplicate values	
	5.2.4 Modify Data in Data Frame	
	5.2.5 Grouping and Aggregating Data	
5.3	Data Visualization (Histogram, Line chart, Bar chart, Scatter plot)	

Books

1. Lubanovic Bill, “Introducing Python-Modern Computing in Simple Packages”, 1st Edition, O’Reilly Publication, 2014
2. Montojo, Jason., Campbell, Jennifer and Gries, Paul, “Practical Programming: An Introduction to Computer Science using Python 3”, 2nd Edition, O’Reilly, 2013
3. Dierbach Charles., “Introduction to Computer Science Using Python”, 1st Edition, Wiley Publication, 2015
4. Mueller, John P., “Beginning Programming with Python for Dummies”, 1st Edition, Dummies, 2014
5. A Beginner’s Python Tutorial: http://en.wikibooks.org/wiki/ABeginner%27s

Savitribai Phule Pune University

Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&T or any faculty except FoS&T for SEMESTER III only

CA – 242 - MNP: Lab Course on CA – 241 - MN

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

Course Objectives:

1. To introduce programming concepts using Python
2. To understand various constructs in Python
3. To test and execute Python programs.

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

CO1: Write Python programs to solve the given problem

CO2: Utilize the data structures such as lists, dictionaries, tuples and sets.

CO3: Use built-in and user defined modules and packages.

CO4: Apply operations involving file systems and data handling.

List of Assignments

Unit 1	**Introduction to Python**	**12 Hrs.**

Assignment on various operator in Python
Assignment on Loop and decision control statement
Assignment on classes and built in functions

Unit 2	**Strings and Functions**	**12 Hrs.**

Assignment on string operators and built-in string functions
Assignment on user defined functions and math functions

Unit 3	**Tuple, Set and Dictionary**	**12 Hrs.**

Assignment on Tuple
Assignment on Sets
Assignment on create dictionary
Assignment on access and manipulates the elements from dictionary.

Unit 4	**Modules and Packages**	**12 Hrs.**

Assignment on importing, Creating and exploring modules
Assignment on Math module, Random module, Time module, Regular expression module.
Assignment on importing package and creating package

Unit 5	**File Handling, Data Handling using (3) Data Frames (3)**	**12 Hrs.**

Assignment on Creating files and Operations on file
Assignment on Data Frame creation and preprocessing on data
Assignment on Data Visualization

Savitribai Phule Pune University

Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&T or any faculty except FoS&T for

SEMESTER IV only

CA - 291- MN: Introduction of Artificial Intelligence and Machine Learning

Teaching Scheme:	Credits	Examination Scheme:
Theory: 02 Hrs./Week	02	Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To learn the core concepts of AI, evolution and different paradigms of AI
2. To understand expert systems and how they utilize knowledge bases and inference engines to solve problems.
3. To study the concepts in machine learning, including supervised, unsupervised, and reinforcement learning.
4. To know the basics of deep learning frameworks.

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

CO1: Describe basic concepts in AI

CO2: Compare different search algorithms used in AI

CO3: Demonstrate understanding of knowledge representation and logic

CO4: apply key machine learning concepts such as supervised, unsupervised, and reinforcement learning.

CO5: Develop the ability to use machine learning algorithms such as linear regression, logistic regression, decision trees.

Course Contents

Unit I	Introduction to Artificial Intelligence and Problem Space	07 Hrs.

1.1 Introduction
1.2 Comparison of AI, Machine Learning, Deep Learning
1.3 AI Techniques and Application of AI
1.4 Agents
  1.4.1 definition and types of agents
  1.4.2 Agent and Environments
  1.4.3 Structure of Agents.
1.5 Defining problem as a State Space Search
1.6 Production System, Problem Characteristics
1.7 Problem Space
  1.7.1 Water Jug Problem
  1.7.2 Missionary Cannibal Problem
  1.7.3 Block Words Problem
  1.7.4 Monkey and Banana Problem

Unit II	Search Algorithms	08 Hrs.

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*

Unit III	**Knowledge Representation and Reasoning**	**08 Hrs.**

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

Unit IV	**Introduction to Machine Learning**	**07 Hrs.**

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

Books

1. Norvig, Peter., and Russell, Stuart., “Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson, 2009
2. Knight, Kelvin. and Rich, Elaine., “Artificial Intelligence”, 3rd Edition, McGrawhill Publication, 2017
3. Geron, Aurelien., “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow”, 3rd 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”, 1st 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

Savitribai Phule Pune University

Minor Course offered by BOS (Computer Applications) to any other BOS under FoS&T or any faculty except FoS&T for

SEMESTER IV only

CA – 292 – MNP: Lab Course on CA - 291 - MN

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

Course Objectives:

1. To learn to use algorithms in AI and machine learning
2. To understand various machine learning techniques, libraries and tools

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

CO1: Apply the suitable AI algorithms to solve a given problem
CO2: preprocess real-world data, including handling missing values, outliers, and scaling
CO3: Use appropriate machine-learning libraries and tools
CO4: solve problems using machine learning techniques.

List of Assignments

Assignment 1	**Artificial Intelligence and Problem Space**
• Water Jug Problem • Missionary Cannibal Problem	
Assignment 2	**Problem Space**
• Block Words Problem • Monkey and Banana Problem	
Assignment 3	**Search Algorithms**
• Breadth-First Search • Depth-First Search	
Assignment 4	**Search Algorithms**
• Constraint Satisfaction	
Assignment 5	**Generate and Test**
• Simple Hill Climbing • Best First Search	
Assignment 6	**Testing and Analysis**
• Mean End Analysis • A^* and AO^*	
Assignment 7	**Knowledge Representation**
• Procedural Knowledge • Declarative Knowledge	
Assignment 8	**Reasoning**

• Propositional Logic • Predicate Logic	
Assignment 9	**Machine Learning Libraries**
• Scikit-learn, pandas, NumPy • Jupiter Notebook basics • Introduction to Google Collab	
Assignment 10	**Data Cleaning**
• User defined data frame creation • Missing data, noise removal	
Assignment 11	**Data Visualization Techniques**
• Data visualization techniques using Matplotlib and Seaborn	
Assignment 12	**GenAI**
• Use GenAI to acquire the knowledge in structured format like if then else rule.	

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

Savitribai Phule Pune University

Open Elective course offered by BOS (Computer Applications) to any faculty except FoS&T for SEMESTER III only

OE – 201 – CA: Introduction to Artificial Intelligence

Teaching Scheme: Theory: 02 Hrs./ Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To learn the core concepts of AI, evolution and different paradigms of AI
2. To understand expert systems and how they utilize knowledge bases and inference engines to solve problems.
3. To study the concepts in machine learning, including supervised, unsupervised, and reinforcement learning.
4. To know the basics of deep learning frameworks

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

CO1: Describe basic concepts in AI

CO2: Compare different search algorithms used in AI

CO3: Demonstrate understanding of knowledge representation and logic

CO4: Compare supervised, unsupervised, and reinforcement learning.

Course Contents

Unit I	Introduction to Artificial Intelligence	04 Hrs.

1.1 Introduction
1.2 Comparison of AI, Machine Learning, Deep Learning
1.3 Applications of AI
1.4 AI Techniques
1.5 Agents and Types of Agents, Agents and Environments, Structure of Agents

Unit II	Problems, Problem Spaces and search	04 Hrs.

2.1 Defining problem as a State Space Search
2.2 Production System
2.3 Problem Characteristics
2.4 Search and Control Strategies
2.5 Problems- Water Jug problem, Missionary Cannibal Problem, Block words Problem, Monkey and Banana problem

Unit III	Knowledge Representation and Introduction to Searching Algorithms	12 Hrs.

3.1 Knowledge Representation
- 3.1.1 Introduction
- 3.1.2 Types of knowledge
- 3.1.3 Approaches to Knowledge Representation
- 3.1.4 Applications of Knowledge Representation

3.2 Search Algorithm
- 3.2.1 Elements of AI search algorithms
- 3.2.2 Importance of Search Algorithm
- 3.2.3 Types of AI search algorithms (BFS, DFS, A^* and AO^*)
- 3.2.4 Applications

Unit IV	Machine Learning	10 Hrs.

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

Books

1. Knight, Kelvin. and Rich, Elaine., “Artificial Intelligence”, 3rd Edition, Mc-Graw Hill Publication, 2017
2. Ertel, Wolfgang and Black Nathanael T., “Introduction to Artificial Intelligence”, Springer,2011
3. Mitchell, Tom M., “Machine Learning”, McGraw Hill, 1997
4. Nilsson Nils J., “Artificial Intelligence: A New Synthesis”, Morgan Kaufman, 1998
5. Ethem, Alpaydin., “Introduction to Machine Learning”,3rd Edition, PHI Publication, 2015

Savitribai Phule Pune University

Open Elective course offered by BOS (Computer Applications) to any faculty except FoS&T for SEMESTER IV only

OE – 251 – CA: Software Tools for Office Administration

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

Course Objectives:

1. To be familiarize with office automation tools for efficient document management, data processing, and communication.
2. To understand tools for word processing, spreadsheets, presentations, and data collection to enhance office productivity.
3. To study tools for collaboration and management of files using cloud-based platforms like Google Drive and OneDrive securely.
4. To learn email etiquette, calendar scheduling, and cyber security for professional office administration.

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

CO1: Apply word processing techniques to create, format, and manage professional documents

CO2: Use spreadsheet tools for data entry, analysis, visualization, and decision-making.

CO3: Design and deliver interactive professional presentations using animations and multimedia integration.

CO4: Create and analyze Google Forms for data collection, surveys, and automated feedback management.

CO5: Implement email and cloud-based collaboration tools to enhance office communication, scheduling, and document security.

List of Assignments

Document Creation and Communication Tools	15 Hrs.

Assignment 1: Understanding CV Formatting and Design: 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.

Assignment 2: Automating Personalized Communication with Mail Merge: 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

Assignment 3: Writing Formal Emails for Professional Communication: Compose a formal email to your professor requesting a meeting using Gmail or Outlook. Attach a Word file as an agenda.

Spreadsheets for Data Management and Analysis	15 Hrs.

Assignment 4: Data Visualization Using Charts and Conditional Formatting

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.

Assignment 5: Financial Tracking with Google Sheets

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.

Presentations and Multimedia Integration	15 Hrs.

Assignment 6: Enhancing Presentations with Multimedia and Effects

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.

Online Collaboration and Cloud-Based Tools	15 Hrs.

Assignment 7: Creating and Analyzing Surveys Using Google Forms

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.

Assignment 8: Efficient Meeting Scheduling with Google Calendar

Schedule a team meeting using Google Calendar. Add title, date, time, and agenda. Invite at least 3 participants and set a reminder.

Assignment 9: File Management and Collaboration in Google Drive

Organize and share files in Google Drive. Create a folder named "Office Automation Project" and upload at least 3 different files (Doc, Sheet, Slide)

Books

1. Randy, Nordell, “Microsoft Office 365: In Practice”,1st Edition, McGraw-Hill Publication, 2023
2. Steve Tudor, "Excel 2023: The Most Updated Guide to Master Microsoft Excel"
3. Richard Wilson, "Google Forms and Google Sheets for Beginners"
4. Poatsy, Mary Anne., and Davidson, Jason, “Microsoft Word 2021 and 365 for Beginners”, 1st Edition, Pearson Publication, 2022

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 B. Sc. (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. Dhadawe 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
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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

Spreadsheet Applications	
Name of the Faculty	**Name of the College**
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Dr. Razzak Sayyad	Ahmednagar College, AhilyaNagar
Dr. R M Sonar	IIT, Powai, Mumbai
Dr. S A Kadam	Bharati Vidyapeeth, Pune

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