Faculty of Commerce & Management

Savitribai Phule Pune University, Pune

NEP – 2020 Curriculum Draft copy of Syllabus

for

S.Y. Bachelor of Computer Applications (BCA)

(2024 Pattern)

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

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I. 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, 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).

Chairman,
Ad-hoc Board of Studies in Computer Applications Faculty of Commerce and Management, SPPU, Pune

II. Vision:

- Becoming a vibrant knowledge Centre and a Centre of Excellence in teaching, research and extension activities.
- Bringing about conservation, creation advancement and dissemination of knowledge;
- Creating technologically equipped thought and action leaders in a wide range of spheres by providing value-based and high quality education;
- Generating cutting edge research and innovations and enabling empowerment through social and regional inclusion;
- Increasing global linkages by attracting international students and establishing collaborative programmes with educational institution of repute

III. Mission:

"The Mission of Savitribai Phule Pune University is to be a global, socially conscious Center of Excellence in the conservation, creation, Advancement and dissemination of knowledge, equipped to take up challenges of the enormous change taking place all around and committed to empower its faculty and students to contribute meaningfully to economic, technological and social development and progress.**"**

IV. Aims:

- Becoming a vibrant Knowledge Center and a Center of Excellence in teaching, research and extension activities;
- Bringing about conservation, creation, advancement and dissemination of knowledge.
- Creating technologically equipped thought and action leaders in a wide range of spheres by providing value based and high quality education, generating cutting-edge research and innovations, and enabling empowerment through social and regional inclusion;
- Increasing global linkages by attracting international students and establishing collaborative Programmes with educational institutions of repute.

V. Learning Outcome Based Curriculum Framework -

1. Programme Education Objectives:

The Bachelor of Computer Application (Honors) Four Years degree programme has the following objectives…

I. To prepare the youth to take up positions as system analysts, system engineers, software engineers and programmers.

II. To aim at developing 'systems thinking' 'abstract thinking', 'skills to analyze and synthesize', and 'skills to apply knowledge', through 'extensive problem solving sessions', 'hands on practice under various hardware/software environments' and' projects developed'.

III. To prepare students with 'social interaction skills', 'communication skills', 'life skills', 'entrepreneurial skills', and 'research skills' which are necessary for career growth and for leading quality life are also imparted.

2. Programmme Outcomes (POs) :

On completion of BCA / (Honors) Three / Four Year Degree Programme the expected programme outcomes that a student should be able to demonstrate are the following:

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

VI. Duration of the programme:

The duration of the BCA Bachelor's degree Program having six semesters and BCA (Honors) Degree Program is of four years spread across Eight Semesters with multiple entry and exit options. Student should complete the 3/4 years degree programme within 5/6 years.

a) Following EXIT options are available with the students:

Exit Option	**Minimum Credits Requirements**	**NSQF Level**
Under graduate Certificate - After successful completion of First Year	44	5
Under graduate Diploma - After successful completion of Second Year	88	6
Bachelor's Degree - After successful completion of Third Year	132	7
Bachelor's Degree with Honors- After successful completion of Fourth Year OR **Bachelor's Degree with Honors (Research) -** After successful completion of Fourth Year	176 176	8

Note : Student is free to complete some interdisciplinary courses from other institutes provided he/she should earn 50% required credits from home HEI.

Student should complete the core disciplinary courses from home University (HEI) to get exit option for UG certificate/ UG diploma/ Bachelor Degree.

b) Following Entry options are available with the students :

- Student who opt Exit option at the end of 1st / 2nd /3rd year, can reenter the same programme within three years from Exit.
- Student with Bachelors Degree can opt for Bachelor degree with Honors
- Student with Bachelors Degree can opt for Bachelor degree with Honors (Research) if the student secure CGPA >= 7.5

National Skills Qualifications Framework (NSQF) Levels :

Option	NSQF Level	Professional Knowledge	Skill
At the end of first year	**5**	Knowledge of facts, principles, processes, concepts in a field of work or study	The student will have fundamental knowledge of computation, problem solving ability and basic website designing ability.
At the end of Second year	**6**	Factual and theoretical knowledge in the broad context within a field of work or study	Additionally the student will have advanced programming skills along with system development ability
At the end of Third year	**7**	Wide ranging factual and theoretical knowledge in the broad context within a field of work or study	Additionally, student will have skills of Web Application development with Technical Writing and Report Generation.
At the end of Fourth year	**8**	Comprehensive, cognitive theoretical knowledge and practical skills to develop creative solutions to abstract problem	Additionally, student will have skills of solving business application applying advanced technology

VII. Academic Bank Of Credits (ABC) :

As per the National Educational Policy (NEP) 2020, the Academic Bank of Credit offer the flexibility of curriculum framework and interdisciplinary /multidisciplinary academic mobility of students across Higher Educational Institutes (HEIs) with appropriate credit transfer mechanism.

The credits earned by the student/learner will be stored in it. A Student/learner would be required to complete the course as per the ABC (Academic Bank Credit) policy of UGC. The validity of the credits earned for a course is seven years only.

VIII. Eligibility Criteria for admission:

A candidate applying for BCA(Honors) Four years programme should have passed higher secondary (10 + 2) or equivalent examination (10+3) of any recognized Board with satisfying the conditions to pass a common All India Entrance test (MAH-BCA CET) conducted by CETCELL. The final admission is based solely on the merit of CET.

Ⅸ. Grading System for Programmes under Management Studies:

- **Grade Points** : The 10-point grading system for all Programmes designed by its various Board of Studies. A grading system is a 10-point system if the maximum grade point is 10. The system is given in Table below.

Table I: The 10-point Grading System Adapted for Programmes

Range of Percent Marks	[90,100]	[75,89]	[60,74]	[55,59]	[50,54]	[45,49]	[40,44]	[00,39]	Nil
Grade Point	10.0	9.0	8.0	7.0	6.0	5.0	4.0	0.0	0.0
Grade	**O**	**A+**	**A**	**B+**	**B**	**C**	**D**	**F**	**AB**

Formula to calculate GP is as under:

Set x = Max/10 where Max is the maximum marks assigned for the examination (i.e. 100) Formula to calculate the individual evaluation

Range of Marks	Formula for the Grade Point
$8x \leq \text{Marks} \leq 10x$	10
$5.5x \leq \text{Marks} \leq 8x$	Truncate (M/x) +2
$4x \leq \text{Marks} \leq 5.5x$	Truncate (M/x) +1

- **Scheme of Examination**

Courses having Internal Assessment (IA) and University Examinations (UE)shall be evaluated by the respective constituent units and the University at the term end for **40** and **60** Marks respectively. The total marks of IA and UE shall be 100 Marks and it will be converted into grade points and grades.

For Internal Assessment (IA) the subject teacher may use the following assessment tools:

a) ***Attendance***
b) ***Class Tests***
c) ***Presentations***
d) ***Class Assignments***
e) ***Case studies***
f) ***Practical Assignments***
g) ***Mini Projects***
h) ***Oral***

X) MOOCs Policy:-

As per the guidelines provided by UGC each student have to complete TWO MOOCs (Massive Open Online Courses) as add on Course which provides wide access to the online learning. The student of regular programme should complete MOOCs prescribed by the institute in semester III, Sem IV, and / or Sem V. Each MOOC will be evaluated for TWO credits. The MOOC course fees should be borne by the respective student. On successful completion of MOOCs course, the student should produce the completion certificate to the institute on the basis of which additional Credits will be given to the students.

Following are the sources from where students can undertake MOOCs

1. iimb.ac.in
2. swayam.gov.in
3. alison.com
4. edx.org
5. Coursera
6. harvardx.harvard.edu
7. udemy.com
8. futurelearn.com
9. Indira Gandhi National Open University (IGNOU)
10. National Council of Educational Research and Training (NCERT)
11. National Institute of Open Schooling (NIOS)
12. National Programme on Technology Enhanced Learning (NPTEL)
13. Any other sources offering online courses suggested by institute

XI. Standard of Passing:

For all courses, both UE and IA constitute separate heads of passing. In order to pass in such courses and to earn the assigned credits, the student/learner must obtain a minimum grade point of 4.0 (40% marks) at UE and also a minimum grade point of 4.0 (40% marks) at IA.

If Student fails in IA, the learner passes in the course provided, he/she obtains a minimum 25% marks in IA and GPA for the course is at least 6.0 (50% in aggregate). The GPA for a course will be calculated only if the learner passes at UE.

A student who fails at UE in a course has to reappear only at UE as backlog candidate and clear the Head of Passing. Similarly, a student who fails in a course at IA he has to reappear only at IA as backlog candidate and clear the Head of Passing to secure the GPA required for passing.

The 10 point Grades and Grade Points according to the following table

Sr. No.	Range of Marks (%)	Grade Point	Grade Letter
1	90≤Marks≤100	10	O (Outstanding)
2	75≤Marks<89	9	A+ (Excellent)
3	60≤Marks<74	8	A (Very Good)
4	55≤Marks<59	7	B+ (Good)
5	50≤Marks<54	6	B (Above Average)
6	45≤Marks<49	5	C (Average)
7	40≤Marks<44	4	D (Pass)
8	Marks < 40	0	F (Fail)
9	Nil	0	Ab (Absent)

The performance at UE and IA will be combined to obtain GPA (Grade Point Average) for the course. The weights for performance at UE and IA shall be 60% and 40% respectively.

GPA is calculated by adding the UE marks out of 60 and IA marks out of 40. The total marks out of 100 are converted to grade point, which will be the GPA.

Formula to calculate Grade Points (GP)

Suppose that "Max" is the maximum marks assigned for an examination or evaluation, based on which GP will be computed. In order to determine the GP, Set x = Max/10 (since we have adopted 10 point system). Then GP is calculated by the following formulas

Range of Marks	Formula for the Grade Point
8x ≤ Marks≤10x	10
5.5x ≤ Marks<8x	Truncate (M/x) +2
4x ≤ Marks<5.5x	Truncate (M/x) +1

Two kinds of performance indicators, namely the Semester Grade Point Average (SGPA) and theCumulative Grade Point Average (CGPA) shall be computed at the end of each term. The SGPAmeasures the cumulative performance of a learner in all the courses in a particular semester, while the CGPA measures the cumulative performance in all the courses since his/her enrolment. The CGPA of learner when he /she completes the programme is the final result of the learner.

The SGPA is calculated by the formula

$$SGPA = \sum Ck * GPk / \sum Ck$$

where, Ck is the Credit value assigned to a course and GPk is the GPA obtained by the learner in the course. In the above, the sum is taken over all the courses that the learner has undertaken for the study during the Semester, including those in which he/she might have failed or those for which he/she remained absent. **The SGPA shall be calculated up to two decimal place accuracy.**

The CGPA is calculated by the following formula

$$CGPA = \frac{\Sigma C_k * GP_k}{\Sigma C_k}$$

where, Ck is the Credit value assigned to a course and GPk is the GPA obtained by the learner in the course. In the above, the sum is taken over all the courses that the learner has undertaken for the studyfrom the time of his/her enrolment and also during the semester for which CGPA is calculated.

The CGPA shall be calculated up to two decimal place accuracy.

The formula to compute equivalent percentage marks for specified CGPA:

% marks (CGPA)	10 * CGPA-10	If 5.00 ≤ CGPA < 6.00
	5 * CGPA+20	If 6.00 ≤ CGPA < 8.00
	10 * CGPA-20	If 8.00 ≤ CGPA < 9.00
	20 * CGPA-110	If 9.00 ≤ CGPA < 9.50
	40 * CGPA-300	If 9.50 ≤ CGPA ≤ 10.00

XII. Award of Honours:

A student who has completed the minimum credits specified for the programme shall be declared to have passed in the programme. The final result will be in terms of letter grade only and is based on the CGPA of all courses studied and passed. The criteria for the award of honours are given below.

Range of CGPA	**Final Grade**	**Performance Descriptor**	**valent Range of Marks (%)**
9.5≤CGPA ≤10	O	Outstanding	80≤Marks≤100
9.0≤CGPA ≤9.49	A+	Excellent	70≤Marks<80
8.0≤CGPA ≤8.99	A	Very Good	60≤Marks<70
7.0≤CGPA ≤7.99	B+	Good	55≤Marks<60
6.0≤CGPA ≤6.99	B	Average	50≤Marks<55
5.0≤CGPA ≤5.99	C	Satisfactory	40≤Marks<50
CGPA below 5.0	F	Fail	Marks below 40

XIII. Rules of ATKT:

a) For admission to Semester V of BCA Third year, Students/Learners should pass all the courses under Sem I and II.

ii) For admission to Semester VII of BCA Fourth year, Students/Learners should pass all the courses under Sem I, II ,III and IV.

XIV. INTERNSHIP :

At the end of Semester VI, each student shall undertake Internship in an Industry for 50 (Fifty Days). It is mandatory for the students to seek written approval from the Faculty Guide about the Topic & the Organisation before commencing the Internship.

During the Internship students are expected to take necessary guidance from the faculty guide allotted by the Institute. To do it effectively they should be in touch with their guide through e-mail or telecom. Internship Project should be a Computer Application to Real life business activity.

The learning outcomes and the utility to the organization must be highlighted in Internship Project Report.

General chapterization of the report shall be as under:

1) Introduction
2) Theoretical background
3) Company profile
4) Objectives of the study

5) System Requirements
6) System Analysis & Design
7) Implementation & Testing
8) Conclusion & Suggestions
9) References:
10) Annexure:

TECHNICAL DETAILS:

1. The report shall be printed on A-4 size white bond paper.
2. 12 pt. Times New Roman font shall be used with 1.5 line spacing for typing the report.
3. 1" margin shall be left from all the sides.
4. Considering the environmental issues, students are encouraged to print on both sides of the paper.
5. The report shall be hard bound as per the standard format of the cover page given by the Institute and shall be golden embossed.
6. The report should include a Certificate (on company's letter head) from the company duly signed by the competent authority with the stamp.
7. The report shall be signed by the respective guide(s) & the Director of the Institute 10 (Ten) days before the viva-voce examinations.
8. Student should prepare two hard bound copies of the Summer Internship Project Report and submit one copy in the institute. The other copy of the report is to be kept by the student for their record and future references.
9. In addition to this students should prepare two soft copies of their Summer IP reports & submit one each in Training & Placement Department of the Institute & Library

The Internship shall be assessed out of 200 Marks. The breakup of these marks is as under;

Viva- voce examination = 120 (One Hundred Twenty) Marks
Internship Report = 80 (Eighty) Marks

Total 200 (Two Hundred) Marks

The examiners' panel shall be decided as per the guidelines received from the University.

The viva –voce shall evaluate the project based on

i. Actual work done by the student in the organization
ii. Student's knowledge about the company & Business Environment
iii. Learning outcomes for the student
iv. Utility of the study to the organization

XV. Project (community Based/Software based)

The project work would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

As a part of Sem-VII, each student shall undertake Community based project related the areas of community engagement and service, environmental education, and value-based education.

It is mandatory for the students to seek written approval from the Faculty Guide about the Topic before commencing the project work. The topic may relate survey based or software based problem. The learning outcomes and the utility to the society must be highlighted in Project Report.

XVI. Specializations:

BCA three year degree programme and BCA(Hons.) four year degree programme 2022 offers specialization to the students/learners in the third year of both the programmes. The students/learner are required to select any one specialization from the list provided below.

Sr. No.	Specialization Course	Course No	Course Name
01	**Data Analysis**	504-1-A	Data analysis using Excel
		604-1-B	R Programming
02	**Information Security**	504-2-A	Information Security Concepts
		604-2-B	Information Security Administration
03	**Data Science**	504-3-A	Statistical Programming using R
		604-3-B	Introduction to Data Science
04	**Information Systems**	504-4-A	E-Commerce
		604-4-B	Knowledge Management

Prerequisite for offering the specialization –

- There must be minimum 10 (Ten) students for a particular specialization.

XVII. Course Structure:

Level 4.5 (FY) Semester - I

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-101-T	Subject 1	Problem Solving and Programming in C	02	--	--	15	35	**50**	02	--	--	**02**
CA-102-P		Lab course on CA-101–T	--	--	04	15	35	**50**	--	--	02	**02**
CA-103-T	BCA	Computer Organization & Architecture	02	--	--	15	35	**50**	02	--	--	**02**
CA-104-P		Lab course on CA-103–T	--	--	04	15	35	**50**	--	--	02	**02**
CA-105-T	BCA	Discrete Mathematics and Statistics	02	--	--	15	35	**50**	02	--	--	**02**
CA-106-P		Laboratory course on CA-105 - T	--	--	04	15	35	**50**	--	--	02	**02**
OE-101-CA	GE/ OE	Introduction to Data Science	02	--	--	15	35	**50**	02	--	--	**02**
VSEC-101-CA	VSEC	HTML and Web Page Designing	--	--	04	15	35	**50**	--	--	02	**02**
IKS – 100 – T	IKS Generic	Course from Basket of courses prepared by the University	02	--	--	15	35	**50**	02	--	--	**02**
AEC – 101 - ENG	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
VEC – 101 - ENV	VEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
Total			**14**	**00**	**16**	**165**	**385**	**550**	**14**	**00**	**08**	**22**

Level 4.5 (FY) Semester - II

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-151-T	Subject 1	Advanced C Programming	02	--	--	15	35	**50**	02	--	--	**02**
CA-152-P		Lab course on CA-151–T	--	--	04	15	35	**50**	--	--	02	**02**
CA-153-T	BCA	Introduction to Microcontrollers	02	--	--	15	35	**50**	02	--	--	**02**
CA-154-P		Lab course on CA-153-T	--	--	04	15	35	**50**	--	--	02	**02**
CA-155-T	BCA	Linear Algebra	02	--	--	15	35	**50**	02	--	--	**02**
CA-156-P		Laboratory course on CA-155 - T	--	--	04	15	35	**50**	--	--	02	**02**
OE-151-CA	GE/ OE	Data Science Using Spreadsheet Software	--	--	04	15	35	**50**	--	--	02	**02**
VSEC-151-CA	VSEC	Software Tools for Business Communications	--	--	04	15	35	**50**	--	--	02	**02**
AEC-151-ENG	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
VEC – 151 - ENV	VEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
CC – 151 - PE	CC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
Total			**12**	**00**	**20**	**165**	**385**	**550**	**12**	**00**	**10**	**22**

Exit option: Award of UG Certification in Bachelor of Computer Application (BCA) with 44 credits and an additional 08 credits (for either courses by Microsoft/CCNA/Salesforce/Google/AWS/Oracle/ RedHat etc or Swayam/ NPTEL/MKCL equivalent to core NSQF course or an Internship) or else Continue with Major and Minor

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	02	--	--	15	35	**50**	02	--	--	**02**
CA-202-MJP		Lab course on CA- 201 -MJ	--	--	04	15	35	**50**	--	--	02	**02**
CA-211-VSC	VSC	C++ Programming	02	--	--	15	35	**50**	02	--	--	**02**
CA-221 -VSC	VSC	Lab course on CA-211-VSC	--	--	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 ELS - 241 –MN	--	--	04	15	35	**50**	--	--	02	**02**
OE-201-CA	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**
CA-241-MN	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
CA-242-MN	CC	Course from University Basket	--	--	04	15	35	**50**	--	--	02	**02**
Total			**12**	**00**	**20**	**165**	**385**	**550**	**12**	**00**	**10**	**22**

Structure of SY Bachelor of Computer Applications Level 5.0

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**
OE-251-CA	GE/OE	Course from University Basket	--	--	04	15	35	**50**	--	--	02	**02**
SEC-251-CA	SEC	Spreadsheet Applications	--	--	04	15	35	**50**	--	--	02	**02**
CA-291-MN	AEC	Course from University Basket	02	--	--	15	35	**50**	02	--	--	**02**
CA-292-MN	CC	Course from University Basket	--	--	04	15	35	**50**	--	--	02	**02**
Total			**08**	**00**	**28**	**165**	**385**	**550**	**08**	**00**	**14**	**22**

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

SYLLABUS
SEMESTER III

Savitribai Phule Pune University Second Year Bachelor of Computer Applications

CA – 201 - MJ: Data Structures

Teaching Scheme: Theory: 02 Hrs./Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester: 35 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	05 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	05 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	05 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	05 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	05 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

Unit VI	Graphs	05 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)

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 Bachelor of Computer Applications

CA - 202 - MJP: Lab course on CA – 201 – MJ

Teaching Scheme: Practical: 04 Hrs./Week/ Batch	Credits 02	Examination Scheme: 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, computedepth, 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 Bachelor of Computer Applications

CA – 211 - VSC: C++ Programming

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

Course Objectives:

1. To understand of basic object-oriented concepts.
2. To understand C++ features like operator overloading, constructor and destructor, inheritance, polymorphism.
3. To test and execute C++ programs.

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

CO1: To understand and apply Object-Oriented Programming (OOP) principles.

CO2: Implement core C++ features for structured programming

CO3: To understand, develop robust and flexible C++ concepts using advanced OOP features.

CO4: Master polymorphism and file handling for practical C++ solutions.

Course Contents

Unit I	**Introduction to C++**	**02 Hrs.**

1.1 Basic concepts, advantages and applications of OOP
1.2 Introduction, applications of C++
1.3 Input and Output operator in C++
1.4 Elementary C++ program

Unit II	**Beginning with C++**	**05 Hrs.**

2.1 Data type and Keywords
2.2 Declaration of variables, dynamic initialization of variables, reference variable
2.3 Operators: Scope resolution operator, Memory management operators
2.4 Manipulators
2.5 Functions: Function prototyping, call by reference and return by reference, Inline functions

Unit III	**Classes and Objects**	**06 Hrs.**

3.1 Class, Object and its structure
3.2 Access specifiers, defining data member
3.3 Defining member functions
3.4 C++ program using class
3.5 Memory allocation
3.6 Static data members and static member functions
3.7 Array of objects
3.8 Friend function and Friend class

Unit IV	Constructors and Destructors	05 Hrs.
4.1 Constructors and its types 4.2 Multiple constructors in a class and with default argument 4.3 Dynamic constructor 4.4 Destructor		
Unit V	**Inheritance**	**04 Hrs.**
5.1 Introduction: Defining Base class and Derived class 5.2 Types of Inheritance 5.3 Virtual base class and abstract class		
Unit VI	**Polymorphism**	**04 Hrs.**
6.1 Compile Time Polymorphism: Introduction, rules for overloading operators, Function overloading, Operator Overloading, String manipulation using operator overloading 6.2 Runtime Polymorphism: Virtual functions and pure virtual functions		
Unit VII	**Managing console, I/O operations**	**04 Hrs.**
7.1 C++ streams and C++stream classes 7.2 Formatted and Unformatted I/O operations 7.3 File Handling: Stream Classes for File operations, File operations -Opening, Closing and updating, File updating with random access. Error handling during File operations		

Books

1. Balagurusamy, E., "Object-Oriented Programming with C++", 8th Edition, McGraw Hill Education, 2020.
2. Stroustrup, Bjarne, "The C++ Programming Language", 4th Edition, Addison-Wesley Professional, 2013.
3. Lippman, Stanley B., Lajoie, Josée, and Moo, Barbara E., "C++ Primer", 5th Edition, Addison-Wesley Professional, 2012.
4. Stroustrup, Bjarne, "Programming: Principles and Practice Using C++", 2nd Edition, Addison-Wesley Professional, 2014.
5. Schildt, Herbert, "The Complete Reference C++", 4th Edition, McGraw Hill Education, 2003.
6. Lafore, Robert, "Object Oriented Programming in C++", 4th Edition, Sams Publishing, 2002.

Savitribai Phule Pune University Second Year Bachelor of Computer Applications

CA - 221 - VSC: C++ Programing

Teaching Scheme: Practical: 04 Hrs./ Week / Batch	Credits 02	Examination Scheme: 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 Bachelor of Computer Applications

CA - 231 - FP: Field work

Teaching Scheme: Practical: 04 Hrs./ Week	Credits 02	Examination Scheme: 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. – 4Weeks
- 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
ELS- 241-MN: Data Communication

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

Course Objectives:

1. To understand various computer networks and technologies behind networks
2. To study TCP/IP protocol suite, IP addressing schemes and link layer communication
3. To study routing concept along with Routing protocols
4. To study application layer protocols
5. To understand basics of cryptography and socket programming

Course Outcomes: After successful completion of this course, the learners will be able to
CO1: Understand the basic concepts of Computer Network, and principle of layering (Understand)
CO2: Apply the error detection and correction techniques used in data transmission (Apply)
CO3: Apply IP addressing schemes and sub netting (Apply)
CO4: Understand the concept of routing protocols, Application layer protocols and Network Security (Understand)
CO5: Apply the socket programming basics to create a simple chat application (Apply)

Course Contents

Unit I	**Introduction to Data Communication**	**5 Hrs.**

1.1 Definition and components of data communication
1.2 Data representation (text, numbers, audio, video)
1.3 Communication models: Sender, Receiver, Medium, Message, Protocol
1.4 Types of data transmission: Analog vs Digital
1.5 Data flow directions: Simplex, Half-duplex, Full-duplex
1.6 Networks and their categories (LAN, WAN, MAN)
1.7Protocols and standards

Unit II	**Transmission Media**	**5 Hrs.**

2.1 Guided Media: Twisted pair, Coaxial cable, Optical fiber
2.1 Unguided Media: Radio waves, Microwaves, Infrared
2.2 Comparison of media types (speed, cost, distance, security)
2.3 Transmission impairments: Attenuation, Noise, Distortion

Unit III	**Data Encoding and Transmission**	**5 Hrs.**

3.1 Digital-to-Digital Encoding (NRZ, Manchester, etc.)
3.2 Analog-to-Digital Conversion (Sampling, Quantization, PCM, Delta Modulation)
3.3 Digital-to-Analog (ASK, FSK, PSK, QAM)
3.4 Analog-to-Analog (AM, FM, PM)
3.5 Bandwidth and Bitrate
3.6 Transmission Modes: Synchronous & Asynchronous

Unit IV	Network Devices and Topologies	5 Hrs.

4.1 Devices: Hub, Switch, Router, Bridge, Gateway, Modem

4.2 Network Topologies: Bus, Ring, Star, Mesh, Hybrid

4.3 Comparison and Applications of each topology

Unit V	Emerging Trends in Data Communication	5 Hrs.

5.1 Mobile communication (4G/5G overview)

5.2 Wireless networks (Wi-Fi, Bluetooth, Zigbee)

5.3 Satellite Communication

5.4 IoT (Internet of Things) basics

5.5 Network virtualisation & cloud-based networking

Books

1. *Data Communications and Networking* – Behrouz A. Forouzan – McGraw-Hill Education
2. *Data and Computer Communications* – William Stallings – Pearson Education
3. *Computer Networks* – Andrew S. Tanenbaum, David J. Wetherall – Pearson Education
4. *Computer Networks* – Atul Kahate – McGraw-Hill Education
5. *Data Communications and Computer Networks* – Prakash C. Gupta – PHI Learning
6. *Computer Networking: A Top-Down Approach* – James F. Kurose, Keith W. Ross – Pearson Education
7. *Data Communication and Networking* – Satish Jain – BPB Publications
8. *Fundamentals of Data Communication and Computer Networks* – D.L. Varshney – S.K. Kataria & Sons
9. *Data Communication & Networks* – Achyut S. Godbole – Tata McGraw-Hill
10. *Understanding Data Communications and Networks* – William A. Shay – Brooks/Cole
11. *Introduction to Data Communications and Networking* – Wayne Tomasi – Pearson Education

Savitribai Phule Pune University Second Year Bachelor of Computer Applications

ELS- 242- MNP: Lab course on ELS – 241 - MN

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

Course Objectives:

1. Understand the fundamental concepts of data communication systems and signal flow mechanisms.
2. Compare different types of transmission media used in guided and unguided communication.
3. Simulate and implement encoding and modulation techniques used in data transmission.
4. Identify, configure, and analyze the role of network devices and common network topologies.
5. Explore and demonstrate real-world applications of modern communication technologies like IoT, Wi-Fi, and 5G.

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

	Bloom's Level	Description
CO1	Understand	Demonstrate understanding of basic data communication concepts
CO2	Analyze	Compare performance of different transmission media
CO3	Apply	Apply encoding techniques using code/simulation
CO4	Apply & Analyze	Configure networks and analyze device functionality
CO5	Evaluate	Explore and evaluate modern communication technologies

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.

Lab Journal Format (for each practical)

- **Practical No. & Title**
- **Objective**
- **Theory / Concept**
- **Tools / Software Used**
- **Procedure**
- **Screenshots / Output**
- **Result / Conclusion**

Assignment Nos	List of Assignments
1	**Simulate Data Flow Types (Simplex, Half-Duplex, Full-Duplex)** ➢ Objective: Understand the direction of data flow using Python or diagram tools. ➢ Tools: Python/C or Packet Tracer animation ➢ Output: Directional flow simulation between sender and receiver
2	**Identify and Document Real-life Examples of Communication Systems** • Objective: Classify systems as analog/digital and simplex/full-duplex. • Task: Fill a table based on TV broadcast, telephone, chat, etc.
3	**Practical 3: Comparative Analysis of Transmission Media** • Objective: Create a table comparing Twisted Pair, Coaxial, Fiber Optic, Microwave, Infrared. • Parameters: Bandwidth, Cost, Distance, Interference, Use Cases
4	**Visual Demonstration of Guided vs Unguided Media** • Tools: Packet Tracer or physical lab hardware • Task: Draw or simulate connections using different media types
5	**Implement Digital Encoding Schemes** • Objective: Write a Python/C program to simulate NRZ, Manchester encoding • Output: Bit pattern visualization with timing diagram
6	**Simulate Analog Modulation Techniques (ASK/FSK/PSK)** • Tool: MATLAB / Python / Simulation tools • Objective: Show how digital bits modulate analog signals
7	**Bit Rate and Baud Rate Calculation** • **Write a small tool or calculator in Python that takes input and shows bit rate vs baud rate**
8	**Identify and Compare Networking Devices** • Devices: Hub, Switch, Router, Modem, Gateway, Bridge • Task: Physical or simulated demo + table of functionalities
9	**Create and Simulate Network Topologies in Packet Tracer** • Topologies: Star, Bus, Ring, Mesh • Task: Connect PCs, assign IPs, test ping
10	**Troubleshoot Network with Commands** • Commands: ping, ipconfig, tracert, arp, netstat • Tools: CMD/Terminal • Task: Interpret outputs and explain

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

Teaching Scheme: Theory: 02 Hrs./Week	Credits 02	Examination Scheme: 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/

SYLLABUS

SEMESTER IV

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

Teaching Scheme: Theory: 04 Hrs./Week	Credits 04	Examination Scheme: 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 Lab: 04 Hrs./ Week/ Batch	Credits 02	Examination Scheme: 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: Practical: 04 Hrs./ Week/ Batch	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 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 Bachelor of Computer Applications

CA – 271 - CEP: Community services

Teaching Scheme: Practical: 04 Hrs./ Week	Credits 02	Examination Scheme: 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 — 4Weeks
- 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: Continuous Evaluation: 15 Marks End-Semester: 35 Marks
Practical: 04 Hrs./ Week / Batch	02	

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

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