

Faculty of Commerce & Management

Savitribai Phule Pune University, Pune



NEP – 2020 Curriculum

(Syllabus)

for

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

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

Table of Contents

Sr.No.	Description	Page No.
I	Preamble	3
II	Vision	4
III	Mission	4
IV	Aims	4
V	Learning Outcome Based Curriculum framework	4
VI	Duration of Programme	6
VII	Academic Bank of Credits (ABC)	7
VIII	Eligibility Criteria for admission	7
IX	Grading System for Programmes under faculty of Management Studies	8
X	MOOC Policy	9
XI	Standard of Passing	10
XII	Award of Honors	12
XIII	Rules of ATKT	12
XIV	Internship	12
XV	Project(Community based/ Software based)	14
XVI	Specializations	14
XVII	Course Structure	15
XVIII	Course Drafts for Courses	27

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. Programme 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 $x = \text{Max}/10$ 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:

- Attendance*
- Class Tests*
- Presentations*
- Class Assignments*
- Case studies*
- Practical Assignments*
- Mini Projects*
- 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	$90 \leq \text{Marks} \leq 100$	10	O (Outstanding)
2	$75 \leq \text{Marks} < 89$	9	A+ (Excellent)
3	$60 \leq \text{Marks} < 74$	8	A (Very Good)
4	$55 \leq \text{Marks} < 59$	7	B+ (Good)
5	$50 \leq \text{Marks} < 54$	6	B (Above Average)
6	$45 \leq \text{Marks} < 49$	5	C (Average)
7	$40 \leq \text{Marks} < 44$	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 $x = \text{Max}/10$ (since we have adopted 10 point system). Then GP is calculated by the following formulas

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

Two kinds of performance indicators, namely the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA) shall be computed at the end of each term. The SGPA measures 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

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

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 study from 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 $5.00 \leq CGPA < 6.00$
	5 * CGPA+20	If $6.00 \leq CGPA < 8.00$
	10 * CGPA-20	If $8.00 \leq CGPA < 9.00$
	20 * CGPA-110	If $9.00 \leq CGPA < 9.50$
	40 * CGPA-300	If $9.50 \leq CGPA \leq 10.00$

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 (%)
$9.5 \leq \text{CGPA} \leq 10$	O	Outstanding	$80 \leq \text{Marks} \leq 100$
$9.0 \leq \text{CGPA} \leq 9.49$	A+	Excellent	$70 \leq \text{Marks} < 80$
$8.0 \leq \text{CGPA} \leq 8.99$	A	Very Good	$60 \leq \text{Marks} < 70$
$7.0 \leq \text{CGPA} \leq 7.99$	B+	Good	$55 \leq \text{Marks} < 60$
$6.0 \leq \text{CGPA} \leq 6.99$	B	Average	$50 \leq \text{Marks} < 55$
$5.0 \leq \text{CGPA} \leq 5.99$	C	Satisfactory	$40 \leq \text{Marks} < 50$
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-221 -VSC	VSC	C++ Programming	02	--	--	15	35	50	02	--	--	02
CA-222 -VSCP	VSC	Lab course on CA- 221	--	--	04	15	35	50	--	--	02	02
CA-231-FP	FP	Field Work	--	--	04	15	35	50	--	--	02	02
ELS-241-MN	MN	Data Communication (Networking)	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	MN	Course from University Basket	02	--	--	15	35	50	02	--	--	02
CA -242-MNP		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	MN	Course from University Basket	02	--	--	15	35	50	02	--	--	02
CA-292-MN		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 I

Savitribai Phule Pune University First Year of B. Sc. (Computer Applications) - (2024 Course) CA – 101 – T : Problem Solving and Programming in C		
Teaching Scheme: Theory: 02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: - To provide a broad overview of problem solving techniques - To learn C programming to solve problems		
Course Outcomes: At the end of the course, students will be able to - Define algorithms and explain their characteristics - Formulate algorithm and draw flow chart to solve a given problem - Explain use of appropriate data types, control statements - Demonstrate ability to use top-down program design		
Course Contents		
Unit I	Problem solving, algorithms and flowcharts	06 Hrs
Types of Problems, Problem solving using computer, Difficulties with problem solving, Problem solving aspects. Definition & Characteristics of algorithm, Examples of algorithms, Flow charts with examples, Top-down design Problem solving using Arithmetic Statements, Conditional Statement & Iterative Statements such as Addition/Multiplication, check number is positive/negative, Maximum of 2 numbers & 3 numbers, sum of first n numbers, sum of given n numbers, reverse digits of a number, check whether the number is palindrome, check number is prime, factorial of number, factors of number, GCD, LCM of numbers etc.		
Unit II	C Fundamentals	07 Hrs
Introduction to C, Features of C, Structure of C Program, C Character Set, Identifiers and Keywords, Variables and constants Data types- Basic data types, Enumerated types, Type casting, Declarations, Expressions, Operators and Expressions Unary and Binary arithmetic operators, Increment Decrement operators, Relational and logical operators, Bit wise operators, Assignment operators, Comma operator, size of operator, Ternary conditional operator, Precedence and associativity Input Output Statements: printf, scanf functions, getchar, putchar, getch functions, gets, puts functions, Escape sequence characters, Format specifiers		
Unit III	Control & Iterative Structures	05 Hrs
If, If- Else Statements, Nested If Statements, Conditional Branching – switch statement, Loop (while, do...while, for), break, continue, goto statements		
Unit IV	Functions	06 Hrs
Introduction to Functions, Function Arguments, Library & User defined functions, Methods for parameter passing, Recursion, Storage Classes – Auto, Static, Global and Register		
Unit V	Arrays	06 Hrs

Introduction, Array Declarations, Bounds Checking, Single dimension Arrays, Two dimension Arrays, Arrays & Function

Reference Books:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to algorithms"
2. Brian W. Kernighan, Dennis M. Ritchie , "The C Programming Language", ISBN:9788120305960, PHI Learning
3. R.G. Dromey, "How to Solve it by Computer", ISBN: 9788131705629, Pearson Education
4. Behrouz A. Forouzan, RichardF. Gilberg, "A Structured Programming Approach Using C", ISBN:9788131500941, Cengage Learning India
5. E. Balaguruswamy, "Programming in ANSI C", ISBN: 9781259004612, Tata Mc-Graw Hill Publishing Co Ltd.-New Delhi
6. Maureen Spankle, "Problem Solving and Programming Concepts", ISBN: 81-317-0711-3
7. Y S Kanetkar, "Let Us C", BPB Publications

Savitribai Phule Pune University
First Year of B. Sc. (Computer Applications) - (2024 Course)
CA – 102 – P : Lab Course on CA – 101 - T

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

- To learn formulation of algorithm for a given problem
- To study various data types, arrays and functions in C
- To understand input-output and, control and iterative statements in C

Course Outcomes: On completion of the course, students will be able to–

- Formulate an algorithm and draw flowchart for the given problem
- Implement the given algorithm in C
- Write programs using appropriate data types and control structures in C

Guidelines for Instructor's Manual

The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion.

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be retained with program prints.

Guidelines for Assessment

Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate

Sr. No.	Assignment List
1	Assignment on use of data types, simple operators (expressions)
2	Assignment on decision making statements (if and if-else, nested structures)
3	Assignment on decision making statements (switch case)
4	Assignment on use of while loops
5	Assignment on use of for loops
6	Assignment on nested loops
7	Assignment on exit, goto, continue, break
8	Assignment on menu driven programs.
9	Assignment on writing C programs in modular way (use of user defined functions)
10	Assignment on call by value
11	Assignment on call by reference
12	Assignment on recursive functions
13	Assignment on use of arrays (1-D array) and functions
14	Assignment on use of multidimensional array (2-D arrays) and functions
15	Assignment on Standard Library Function

Savitribai Phule Pune University
First Year of B. Sc. (Computer Applications) - (2024 Course)
CA – 103 – T : Computer Organization and Architecture

Teaching Scheme: Theory: 02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 30 Marks
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Course Objectives:

- To study number system, logic gates
- To understand combinational and sequential circuits
- To provide a broad overview of architecture and functioning of computer systems
- To learn the basic concepts behind the architecture and organization of computers.

Course Outcomes: On completion of the course, student will be able to–

- Design of combinational circuits
- Design of sequential circuits
- Describe block diagram of CPU, Memory and types of I/O transfers

Course Contents

Unit I	Data representation and Computer Arithmetic	04 Hrs
Review of Decimal, Binary, Octal, Hexadecimal Number systems and their inter-conversion, BCD code, Gray code, Excess-3 code, ASCII , EBCDIC, Unicode, Signed and Unsigned numbers, 1's and 2's complements, Binary arithmetic.		
Unit II	Boolean Algebra & Logic Gates	07 Hrs
Boolean theorems, Boolean Laws, De Morgan's Theorem, Reduction of Logic expression using Boolean Algebra, Introduction to Logic (AND, OR, NOT), Classification of Logic gates, Universal Logic gates, Implementation of other gates using universal gates. Basic concepts of Karnaugh map, minterm and maxterm.		
Unit III	Combinational Circuits	07 Hrs
Definition of combinational circuits, Detail study of Half adder, Full adder, Half subtractor, Full subtractor, Multiplexer(4:1) & Demultiplexer(1:4), Encoder (8-line-to-3-line) and Decoder (3-line-to-8-line), Parity generator and checker, Block diagram of ALU.		
Unit IV	Sequential circuits	07 Hrs
Definition of sequential circuits, Detail study of Flip Flops and truth tables: S-R FF, J-K FF, T and D type FFs, Flip flop as memory device. Counters: Asynchronous-Mod16, Mod-10, Mod-8, up down counter, Synchronous-Ring counter, Event counter. Shift Registers and their types, serial to parallel and parallel to serial converters using shift registers.		
Unit V	CPU, Memory and I/O Organization	05 Hrs

Block diagram of CPU, functions of CPU, general register organization, flags, Concept of RISC and CISC

Memory System hierarchy, Cache Memory, Internal Memory, External Memory, Concept of Virtual Memory.

Basics of I/O organisation: types of I/O data transfers.

Reference Books:

1. R.P. Jain, "Modern Digital Electronics", McGraw-Hill Publications
2. Flod and Jain, "Digital Fundamentals", Pearson Publication.
3. Morris Mano, "Computer System Architecture" Prentice-Hall.

Savitribai Phule Pune University First Year of Bachelor of Computer Applications (2024 Course) CA-104-P: Lab Course on CA-103-T		
Teaching Scheme: Practical: 04 Hours/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: • To study number system, logic gates • To understand combinational and sequential circuits • To provide a broad overview of architecture and functioning of computer systems • To learn the basic concepts behind the architecture and organization of computers.		
Course Outcomes: On completion of the course, student will be able to– • Design of combinational circuits • Design of sequential circuits • Describe block diagram of CPU, Memory and types of I/O transfers		
Guidelines for Instructor's Manual The instructor shall frame at least 12 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, Date of Completion etc. For reference one or two journals may be retained.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage		
List of Assignments		
1. To Study and verify the Truth Tables of Logic Gates. 2. To Study De-morgan's theorems. 3. Code Converters using K-Map. 4. Half Adder and Full Adder. 5. Decimal to BCD Encoder 6. Multiplexer (2:1) and De-multiplexers (1:2) 7. Flip-flops (SR, D and JK-FF) 8. 4-bit binary asynchronous counter using IC 7493. 9. Shift Registers. 10. Study of 4-bit ALU (IC 74181) 11. Study of 3-bit Synchronous Up-Down counter. 12. Parity generator and checker		

Savitribai Phule Pune University First Year of B. Sc. (Computer Applications) - (2024 Course) CA – 105 – T : Discrete Mathematics and Statistics		
Teaching Scheme: Theory: 02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 30
Course Objectives: • Learn basic terminology formal logic, proofs, sets, relations, functions and perform the operations associated with same • Use formal logic proof and logical reasoning to solve problems • To understand significance of statistical measures • To study Correlation and Probability		
Course Outcomes: On completion of the course, students will be able to– • Relate and apply techniques for constructing mathematical proofs and make use of appropriate set operations, propositional logic to solve problems • Use function or relation models to interpret associated relationships • Apply basic counting techniques and use principles of probability • Given a data, compute various statistical measures of central tendency • Use appropriate Sampling techniques		
Course Contents		
Unit I	Set Theory and Logic	06 Hrs
Sets – Set Theory, Need for Sets, Representation of Sets, Set Operations, cardinality of set, Types of Sets – Bounded and Unbounded Sets, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, power set, Propositional Logic - logic, Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.		
Unit II	Relations and Functions	06 Hrs
Relations: Properties, n-ary Relations and Applications, Representing Relations , Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Anti-Chains, Transitive Closure and Warshall's Algorithm Functions - Surjective, Injective and Bijective functions, Inverse Functions and Compositions of Functions.		
Unit III	Counting and Probability	06 Hrs
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, The Pigeonhole Principle. Probability: Basic Concepts, Definition, Addition and Multiplication Theorems, Conditional probability and Bayes' Theorem		
Unit IV	Data Presentation and Aggregation	06 Hrs

Data Types: attribute, variable, discrete and continuous variable, **Data presentation:** frequency distribution, histogram, ogive, box-plot, bar plots

Measures of Central Tendency: Arithmetic Mean (AM), Weighted Arithmetic Mean, Arithmetic Mean Computed from Grouped Data, Concept of Median, Mode, Geometric Mean (GM), Harmonic Mean (HM), Quartiles, Deciles, and Percentiles

Measures of Dispersion: Standard Deviation, Root Mean Square, Variance, Absolute and Relative Dispersion

Unit V	Correlation Theory and Sampling	06 Hrs
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Correlation: Bivariate data, scatter plots, Linear Correlation, Correlation of Attributes, Coefficient of correlation

Regression: Concept, Linear Regression, Prediction

Elementary Sampling Theory : Sampling Theory, Random Samples, Sampling With and Without Replacement, Stratified Sampling

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics And Its Applications, Tata Mcgraw-Hill, Isbn 978-0-07-288008-3, 7th Edition.
2. Trivedi, K.S., " Probability, Statistics, Design Of Experiments And Queuing Theory, With Applications Of Computer Science", Prentice Hall Of India, New Delhi
3. C L Liu, "Elements Of Discrete Mathematics", Tata Mcgraw-Hill, Isbn 10:0-07-066913-9.
4. Kulkarni, M.B., Ghatpande, S.B. And Gore, S.D., "Common Statistical Tests" Satyajeet Prakashan, Pune
5. J.N. Kapur And H.C. Saxena, "Mathematical Statistics", S. Chand Publications, 20th Ed.
6. John P. D'angelo & Douglas B. West, "Mathematical Thinking–Problem Solving And Proofs" Prentice Hall, 2nd Ed.

Savitribai Phule Pune University First Year of B. Sc. (Computer Applications) (2024 Course) CA-106 - P: Laboratory Course Based on CA-105 - T		
Teaching Scheme: Theory: 04 Hours/Week	Credits 02	Examination Scheme: Continuous Evaluation:15 Marks End-Semester :35 Marks
Course Objectives: - To learn to apply theoretical concepts of discrete mathematics and statistics to solve problems. - To provide hands-on experience on R software.		
Course Outcomes: On completion of the course, student will be able to - Demonstrate understanding of fundamental mathematical concepts. - Apply mathematical and statistical concepts to solve problems. - Use R software to perform statistical operations and data visualization.		
Guidelines for Instructor's Manual The instructor shall frame at least 12 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, Date of Completion etc. For reference one or two journals may be retained.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.		
Suggested List of Laboratory Assignments		
Applied Mathematics: Assignment based on following topics		
1. Set Theory 2. Logic 3. Relations 4. Functions 5. Counting		
Statistics (To be performed using R software)		
1. Download and Install R, understand IDE 2. Using R execute the basic commands, array, list and frames. 3. Using R Execute the statistical functions: mean, median, mode, quartiles, range. 4. Using R import the data from Excel / .CSV file and calculate the standard deviation. 5. Import the data from Excel / .CSV and perform the Statistical distribution: Normal Distribution.		
References: Richard Cotton, "Learning R", SPD O'Reilly Publications		

Savitribai Phule Pune University First Year of Bachelor of Computer Applications (2024 Course) VSEC-101-CA: HTML and Webpage Designing		
Teaching Scheme: Practical: 04 Hours/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: - To understand web based application development process. - To study basics of HTML elements and tag. - To know usage of CSS in HTML. - To design and create simple websites. - To apply JavaScript to websites.		
Course Outcomes: After successful completion of this course, learner will be able to - Enlist various HTML elements and tags - Use HTML elements and tags - Apply CSS and Java script features. - Design a website using HTML, CSS and JavaScript.		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be retained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.		
List of Assignments		
Assignment 01: Using basic HTML elements (headings, paragraphs, line break, colour, fonts, links, Images, etc)		
Assignment 02: Creating Lists using HTML Tags		
Assignment 03: Creating Tables using HTML Tags		
Assignment 04: Creating Frames in HTML		
Assignment 05: Creating Forms using HTML		
Assignment 06: Designing of HTML screens using CSS		
Assignment 07: Using Functions in JavaScript		
Assignment 08: Carryout Validation using JavaScript		
Assignment 09: Using Event Handling.		

Assignment 10: Designing website using basic elements of HTML, CSS and JavaScript.
Assignment 11: Designing website using HTML, CSS and advanced JavaScript elements and event handling
Reference Books:
1. Steven Holzner, HTML Black Book, Dremtech press. 2. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India 3. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson Education 4. Programming the World Wide Web , Robert W Sebesta (3rd Edition) 5. Learn HTML and CSS faster by Mark Myer
E-Resources:
1. https://www.coursera.org/learn/html-css-javascript-for-web-developers 2. https://www.coursera.org/learn/introduction-to-web-development-with-html-css-javascript?action=enroll#modules 3. https://www.scribd.com/doc/41532231/CSS-HTML-JavaScript-LAB-Good-Practical-Programs 4. https://www.udemy.com/course/web-development-learn-by-doing-html5-css3-from-scratch-introductory/ 5. https://www.udemy.com/course/javascriptfundamentals/

SYLLABUS SEMESTER II

Savitribai Phule Pune University First Year of B. Sc. Computer Applications (2024 Course) CA – 151 - T: Advanced C Programming		
Teaching Scheme: Theory: 02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: - To learn advanced features in C Programming - To study advanced data types - To understand built-in library functions		
Course Outcomes: On completion of the course, student will be able to– - Write programs using pointers and structures - Use Pre-processor directives - Manipulate strings using library functions - Write programs to perform operations on Files		
Course Contents		
Unit I	Preprocessor	06 Hrs
Concept, Format of preprocessor directives, File inclusion directives (#include), Macro substitution directives (#define), nested macros, parameterized macros, Macros versus functions, #error / #pragma directives, Conditional compilation (#if/#ifdef/#else/#elif/#endif), Predefined macros (_DATE_ / _TIME_ / _FILE_ / _LINE_ / _STDC_)		
Unit II	Pointers	07 Hrs
Concept – reference & dereference, Declaration, definition, initialization & use, Types of pointers, Pointer Arithmetic, Multiple indirection, parameter passing – call by value and call by reference Arrays & Pointers - Pointer to array, Array of pointers, Functions & pointers - Passing pointer to function, Returning pointer from function, Function pointer, Pointers & const Dynamic memory management, Allocation, Resizing, Releasing, Memory leak / dangling pointers		
Unit III	Strings	05 Hrs
Concept, Declaration, definition, initialization, format specifiers, String literals/ constants & variables – reading & writing from & to console, Importance of terminating NULL character, Strings & pointers Array of strings & array of character pointers, User defined functions, predefined functions in string.h - strlen , strcpy , strcat , strcmp , strcmpi , strrev , strlwr ,strupr , strset , strchr , strrchr , strstr , strncpy , strncat , strncmp , strncmpi , strnset , strtok, Command line arguments – argc and argv		
Unit IV	Structures	06 Hrs

Concept, Declaration, definition, initialization, accessing structure members (. operator), Array of structures, Pointers to structures, Declaring pointer to structure
 Accessing structure members via pointer to structure, Structures & functions,
 Passing each member of structure as a separate argument, Passing structure by value / address
 Nested structures, typedef & structures, Concept of Union

Unit V	File Handling	06 Hrs
Concept of streams, need, Types of files, Operations on text & binary files, Random access file, library functions for file handling – fopen, fclose, fgetc, fseek, fgets, fputc etc		
Reference Books:		
1. The C Programming Language (Second Edition) – By B. W. Kerninghan & D. M. Ritchie 2. Programming in C – A Practical Approach – By Ajay Mittal (Pearson Publications) 3. Programming with C – By Byron S Gottfried (Schaum's Outlines) 4. A structural Programming Approach using C – By Behrouz Forouzan & Richard Gilberg 5. Y S Kanetkar, "Let Us C", BPB Publications		

Savitribai Phule Pune University
First Year of B. Sc. (Computer Applications) (2024 Course)
CA – 152 – P : Lab Course on CA – 151 - T

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

- To learn advanced features in C Programming
- To study advanced data types
- To understand built-in library functions

Course Outcomes: On completion of the course, student will be able to–

- Write programs using pointers and structures
- Use Pre-processor directives
- Manipulate strings using library functions
- Write programs to perform operations on Files

Guidelines for Instructor's Manual

The instructor shall frame at least 12 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion.

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints.

Guidelines for Assessment

Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.

Sr. No.	Assignment
1	To demonstrate use of preprocessor directives
2	To demonstrate use of pointers
3	To demonstrate advanced use of pointers
4	To demonstrate concept of strings, array of strings
5	To demonstrate string operations using pointers
6	To demonstrate command line arguments
7	To demonstrate structures (using array and functions)
8	To demonstrate nested structures
9	To demonstrate use of bitwise operators.
10	To demonstrate file handling

Savitribai Phule Pune University
First Year of B. Sc. (Computer Applications) - (2024 Course)
CA – 153 – T : Introduction to Microcontrollers

Teaching Scheme:
Theory: 02 Hrs/Week

Credits
02

Examination Scheme:
Continuous Evaluation: 15 Marks
End-Semester : 30 Marks

Course Objectives:

- To study the basics of microcontroller.
- To learn 8051 Programming.
- To understand interfacing techniques of 8051 microcontroller.
- To learn to design simple applications using 8051 microcontroller.

Course Outcomes: On completion of the course, student will be able to–

- Write programs using instruction set of 8051 microcontroller.
- Interface I/O peripherals to 8051 microcontroller.
- Design simple microcontroller-based applications.

Course Contents

Unit I	Introduction	04 Hrs
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Introduction of microcontroller and microprocessor, difference between microcontroller and microprocessor, classification of microcontrollers, Applications of microcontrollers.

Unit II	8051 microcontroller	04 Hrs
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Features of 8051 microcontrollers, block diagram & Architecture of 8051, Internal Memory organization, SFRS, PSW register, pin functions of 8051, Structure of I/O ports and its Operation, External Memory Interface.

Unit III	8051: Programmer's Model	09 Hrs
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Introduction to Assembly programming, Compilers. Assemblers, Instruction classification, Instruction set, Addressing Modes: Immediate, register, direct, indirect and relative, assembler directives (ORG, END), features with examples.
 Introduction to 8051 programming in C.

Unit IV	Timers and Counters	07 Hrs
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Timer / counter: TMOD, TCON, SCON, SBUF, PCON Registers, Timer modes, programming for time delay using mode 1 and mode 2.

Unit V	Interrupts and Interfacing	06 Hrs
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Interrupts: Introduction to interrupt, Interrupt types and their vector addresses, Interrupt enable register and interrupt priority register (IE, IP).
 Basics of Interfacing: ADC, DAC, LCD, stepper motor.

Reference Books:

1. 8051 microcontroller and Embedded system using assembly and C : Mazidi and McKinley, Pearson publications.
2. The 8051 microcontroller – Architecture, programming and applications: K.Uma Rao and Andhe Pallavi, Pearson publications.

Savitribai Phule Pune University First Year of Bachelor of Computer Applications (2024 Course) CA-154-P: Lab Course on CA-153-T		
Teaching Scheme: Practical: 04 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: • To study the basics of microcontroller. • To learn 8051 Programming. • To understand interfacing techniques of 8051microcontroller. • To learn to design simple applications using 8051microcontroller.		
Course Outcomes: On completion of the course, student will be able to– • Write programs using instruction set of 8051 microcontroller. • Interface I/O peripherals to 8051 microcontroller. • Design simple microcontroller-based applications.		
Guidelines for Instructor's Manual The instructor shall frame at least 12 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion etc. Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be retained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage		
List of Assignments		
1. Study of 8051 microcontroller chip, keil μvision-5. 2. Study of proteus simulator for 8051 simulation. 3. Program to find Largest/smallest from a series. 4. Program to perform Addition / subtraction / multiplication/division of 8/16 bit data. 5. Program to perform Arithmetic, logical & code conversion problems 6. Program to perform data transfer/exchange between specified memories locations. 7. Interfacing of LED/LEDs to 8051 microcontroller. 8. Interfacing of switch & LED to 8051 microcontroller. 9. Waveform generation using DAC Interface to 8051 Microcontroller.		

10. Traffic light controller using 8051 microcontroller.
11. Interfacing LCD to 8051Microcontroller.
12. Interfacing with IR sensor to 8051 microcontroller and LCD.
13. ADC interfacing to 8051 Microcontroller.
14. Stepper motor interfacing to 8051 microcontroller.
15. DC motor interfacing to 8051 microcontroller.

Savitribai Phule Pune University First Year of B. Sc. (Computer Applications) - (2024 Course) CA – 155 – T : Linear Algebra		
Teaching Scheme: Theory: 02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 30
Course Objectives: - To offer the learner the relevant Linear Algebra concepts through Computer Science applications. - To interpret existence and analyse the solution set of a system of linear equations. - To formulate, solve, apply, and interpret properties of linear systems. - To learn about the concept of linear independence of vectors and the dimension of a vector space. - To interpret basic concepts of linear transformations, dimension, matrix representation of a linear transformation.		
Course Outcomes: On completion of the course, students will be able to– - Appreciate the relevance and applications of Linear Algebra in the field of Computer Science. - Instill a computational thinking while learning linear algebra. - Express clear understanding of the concept of a solution to a system of equations. - Find eigenvalues and corresponding eigenvectors for a square matrix. - Represent linear transformations using matrices.		
Course Contents		
Unit I	Systems of Linear Equations and Matrices	06 Hrs
1.1 Row echelon form of a matrix, reduced row echelon form of a matrix. 1.2 Definition of rank of a matrix using row echelon or row reduced echelon form. 1.3 System of linear equations- Introduction, matrix form of linear system, definition of row equivalent matrices. 1.4 Consistency of homogeneous and non-homogeneous system of linear equations using rank, condition for consistency 1.5 Solution of System of Equations: Gauss elimination and Gauss-Jordan elimination method, examples.		
Unit II	Vector Spaces - I	06 Hrs
2.1 Definition and examples 2.2 Subspaces 2.3 Linear Dependence and Independence (Statement and examples only) 2.4 Basis of vector space		
Unit III	Vector Spaces - II	06 Hrs
3.1 Dimension of a vector space 3.2 Row Space, Column Space, and Null Space of a matrix 3.3 Definition: Rank and Nullity		
Unit IV	Eigen values and Eigen vectors	06 Hrs
4.1 Eigen values 4.2 Eigen vectors 4.3 Diagonalization		

Unit V	Linear Transformations	06 Hrs
5.1 Definition and Examples, Properties, Equality 5.2 Kernel and range of a linear Transformation 5.3 Rank-Nullity theorem (Statement only) 5.4 Matrix representation of Linear Transformation		
Books:		
Text Book : 1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Application Version, Ninth Edition, Wiley, 11th edition.		
Reference Books: 1. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition(2014), Prentice Hall of India, New Delhi 2. Steven J. Leon, Linear Algebra with Applications, 4th edition(1994), Prentice Hall of India. New Delhi 3. Vivek Sahai, Vikas Bist, Linear Algebra, 4th Reprint 2017, Narosa Publishing House, New Delhi.		

Savitribai Phule Pune University First Year of B. Sc. (Computer Applications) (2024 Course) CA-156 - P: Laboratory Course Based on CA-155 - T		
Teaching Scheme: Theory: 04 Hours/Week	Credits 02	Examination Scheme: Continuous Evaluation:15 Marks End-Semester :35 Marks
Course Objectives: - To learn to apply theoretical concepts of discrete mathematics and statistics to solve problems. - To provide hands-on experience on R software.		
Course Outcomes: On completion of the course, student will be able to - Demonstrate understanding of fundamental mathematical concepts. - Apply mathematical and statistical concepts to solve problems. - Use R software to perform statistical operations and data visualization.		
Guidelines for Instructor's Manual The instructor shall frame at least 12 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, Date of Completion, etc. For reference one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.		
Suggested List of Laboratory Assignments		
Assignments based on following topics		
1. Practical 1: Problems on Unit 1 based on Systems of Linear Equations-I (Written). 2. Practical 2: Problems on Unit 1 based on Systems of Linear Equations-II (Written). 3. Practical 3: Problems on Unit 2 (Written). 4. Practical 4: Problems on Unit 3 (Written). 5. Practical 5: Problems on Unit 4 (Written). 6. Practical 6: Problems on Unit 5 (Written).		
Assignments To be performed using Scilab Software		
7. Practical 7: Introduction to Scilab software. 8. Practical 8: Problems on Unit 1 using Scilab software 9. Practical 9: Problems on Unit 2 using Scilab software.. 10. Practical 10: Problems on Unit 3 using Scilab software. 11. Practical 11: Problems on Unit 4 using Scilab software. 12. Practical 12: Problems on Unit 5 using Scilab software		
References: Richard Cotton, "Learning R", SPD O'Reilly Publications		

Savitribai Phule Pune University First Year of Bachelor of Computer Applications (2024 Course) VSEC-151: Software Tools for Business Communication		
Teaching Scheme: Practical:04 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester: 35 Marks
Course Objectives: - To study word processing, spreadsheets and presentation tools - To learn G-suite - To be familiar with tools for Electronic communications		
Course Outcomes: At the end of the course, students will be able to - Perform various word processing tasks - Prepare spreadsheets and presentations - Collect feedbacks and make surveys - Communicate and collaborate through electronic communications		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.		
Topics for Lab Assignments		
Unit No	Topics	Number of Assignments
Unit I	Word processing and Google DOCs	04 Nos
Create, Save, Open and Edit Documents, Text Alignments, Enhancements, and Effects Basic Document Formatting and Editing, Additional Document Formatting and Editing Work with Multiple-Page Documents and Multiple Documents, Work with Columns and Tables Work with Objects, Lines, and Text Boxes, Drawing Tools, Add Special Effects Create and manipulate Google DOC using various features		
Unit II	Spreadsheets and Google Sheets	04 Nos
Create, Save, and Print a Worksheet, Use Formulas; Copy a Formula; Format and Enhance Use Functions, Additional Formatting, and Editing, Create and Edit Charts, Integrate Worksheets with Other Applications Create and manipulate Google Sheets using various features		

Unit III	Presentations and Google Slides	02 Nos
Create, Save, and Print a Presentation, Enhance Slides; Work with Text and Objects, Work with Slide Shows; Integrate Presentations with Other Applications Create and manipulate Google Slides using various features		
Unit IV	Google Forms, Drives and Calendar	03 Nos
Create, Save, Open and Edit Google form using essential features Google Drive: Create folders and subfolders, upload documents, share drive files and folders, Google Calendar: essential features		
Unit V	Emails, Groups and Generative AI Tools	04 Nos
Create and send, receive emails, email folders and fields, attach documents, address book, email signatures and other essential settings, Email etiquettes Create, join email groups, send and receive emails on groups Using Generative AI tools such as ChatGPT		
Reference Books:		
- Office 2019 in Easy Steps, Michael Price, BPB Publications - The Ridiculously Simple Guide to Google Apps (G Suite): A Practical Guide to Google Drive Google Docs, Google Sheets, Google Slides, and Google Forms, Scott La Counte, SL Editions		

**List of Open Elective (OE) Courses offered
by BOS in Computer Applications
to other Disciplines / Faculty**

Sr. No.	Semester	Course Code	Course Name	Credits		
				TH	PR	Total
1.	I	OE-101-CA	Introduction to Data Science	02	00	02
2.	II	OE-151-CA	Data Science Using Spreadsheet Software	00	02	02
3.	III	OE-201-CA	Introduction to Artificial Intelligence	02	00	02
4.	IV	OE-251-CA	Software Tools for Office Administration	00	02	02

**List of MINOR Courses offered
by BOS in Computer Applications
to other Disciplines / Faculty**

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
5	V	CA-341-MN	Introduction to AR-VR	02	00	02

Syllabus Of
Open Elective Courses offered
by BOS (Computer
Applications)
to
other disciplines/ faculties
for
SEMESTER I and II only

Savitribai Phule Pune University Open Elective offered by BOS in Computer Applications for UG Programs from Faculties other than Faculty of Science & Technology for SEM I ONLY OE-101-CA: Introduction to Data Science (2024 Pattern)		
Teaching Scheme: Theory:02 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: - To understand need of Data Science - To Know role of Statistics in Data Science - To know Data Science Models and Tasks		
Course Outcomes: At the end of the course, students will be able to - Define Data Science Tasks and Models and Lifecycle - Apply Prep-processing and visualization Techniques		
Course Contents		
Unit I	Introduction	06 Hrs
What and why Why learn Data Science?, Types of Data -structured, semi-structured, unstructured Data Applications of Data Science, The Data Science Lifecycle, Role of Data Scientists Data sources-Open Data, Social Media Data, Multimodal Data, standard datasets		
Unit II	Statistics for Data Science	06 Hrs
Data Objects and Attributes, Attribute Types: Nominal, Binary, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes, Role of statistics in Data Science Descriptive statistics - Measuring the Frequency, Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion: Range, Standard deviation, Variance, Inter quartile Range		
Unit III	Data science Models and Tasks	06 Hrs
Predictive and Descriptive Models, Introduction to Data Science Tasks – Classification, Prediction, Association, Clustering, Performing simple Data Science Tasks using WEKA / R		
Unit IV	Data Quality and Pre-processing	06 Hrs
Data Quality: Why Preprocess the Data?, Data munging/wrangling operations Data Cleaning - Missing Values, Noisy Data Data Transformation – Rescaling, Normalizing, Data reduction and Data discretization		
Unit V	Data Visualization	06 Hrs
Introduction to Exploratory Data Analysis (EDA), Data visualization, Basic data visualization tools –Box Plots, Histograms, Bar charts/graphs, Scatter plots, Line charts, Area plots, Pie charts		
Reference Books: Data Science Fundamentals and Practical Approaches, Gypsy Nandi, Rupam Sharma, BPB Publications, 2020.		

2. Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline Kamber, Jian Pei, Morgan Kaufmann, 2012.
3. A Hands-On Introduction to Data Science, Chirag Shah, University of Washington
Cambridge University Press

Savitribai Phule Pune University Open Elective offered by BOS in Computer Applications for UG Programs from Faculties other than Faculty of Science & Technology for SEM II ONLY OE-151-CA: Data Science using Spreadsheet Software (2024 Pattern)		
Teaching Scheme: Practical: 04 Hrs/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks
Course Objectives: • To know spreadsheet concepts • To learn functions and formulas. • To understand charts and graphics. • To be familiar with filters and sorting of table data.		
Course Outcomes: After successful completion of this course, learner will be able to • Perform computations on data using formulas. • Present the data in graphical form. • Analyze data by applying various functions and filters		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate weightage.		
List of Assignments		
Assignment 1: To explore interface and basic features of Excel. Make a Start with Excel from simple to complex spreadsheet. Creating templates in Excel.		
Assignment 2: Using Autocomplete and formatting features. Data entry in Excel with different data types and formatting. Formatting Cells with Number formats, Font formats, Alignment, Borders, etc.		
Assignment 3: Printing Workbooks - Setting Up Print Area, Print Titles –Repeat Rows / Columns, Designing the structure of a template, Customizing Headers & Footers.		
Assignment 4: Filtering and Sorting - Filtering on Text, Numbers & Colours, Sorting Options, Sorting and Filtering Lists.		
Assignment 5: Calculations in MS-Excel using Basic Functions (Sum, Average, Max, Min, Count, etc). Use of Text Functions (Upper, Lower, Proper, Left, Mid, Right , Trim, Len, Exact, Concatenate, Find, Substitute). Use of Arithmetic Functions (SumIf, SumIfs CountIf, Countifs ,Averagelf, Averagelfs).		

Assignment 6: What-If Analysis - Goal Seek, Data Tables, Solver Tool, Scenario Analysis.
Assignment 7: Data Validation- Number, Date & Time Validation, Dynamic Dropdown List Creation using Data Validation – Dependency List, Custom validations based on a formula for a cell, Text and List Validation.
Assignment 8: Generating different types of charts. Using SLICERS, Filter data with Slicers, Various Charts i.e. Bar Charts / Pie Charts / Line Charts, Manage Primary and Secondary Axis.
Assignment 9: Use of conditional functions. Applying IF functions. Conditional formatting in MS-Excel. Use of OFFSET function.
Assignment 10: Recording macros and buttons. Protecting Excel- Excel Security (File Level Protection Workbook, Worksheet Protection).
Assignment 11: Excel Dashboard, Planning a Dashboard, Adding Dynamic Contents to Dashboard, Adding Tables and Charts to Dashboard.
Assignment 12: Use of Lookup functions. (Vlookup / HLookup), Creating Smooth User Interface Using Lookup, Reverse Lookup using Choose Function.
Assignment 13: Creating Simple Pivot Tables, Classic Pivot table, Basic and Advanced Value Field Setting, Calculated Field & Calculated Items, Grouping based on numbers and Dates.
Assignment 14: Arrays Functions - What are the Array Formulas, Use of the Array Formulas? Array with if, len, and mid functions formulas, Basic Examples of Arrays (Advanced Use of formulas with Array, Array with Lookup functions).
Reference Books 1. Beginning Excel 2019, Authors: Noreen Brown, Barbara Lave, Julie Romey, Open Oregon Educational Resources 2. Excel Step by Step (Office 2021 and Microsoft 365) Published with the authorization of Microsoft Corporation by: Pearson Education, Inc. 3. Excel Bible: The Comprehensive Tutorial Resource 4. Excel: Quick Start Guide from Beginner to Expert (Excel, Microsoft Office) 5. Building Financial Models with Excel: A Guide for Business Professionals, (MISL-WILEY) 6. Predictive Analytics: Excel 7. Excel from Scratch: Excel course with demos and exercises
E-Resources: 1. https://www.udemy.com/course/microsoft-excel-2013-from-beginner-to-advanced-and-beyond/ 2. https://edu.gcfglobal.org/en/excel/ 3. https://support.microsoft.com/en-us/excel 4. https://www.coursera.org/projects/introduction-microsoft-excel 5. https://www.coursera.org/learn/microsoft-excel-work-smarter 6. https://www.udemy.com/course/excel-for-analysts/

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

Unit IV	Stacks and Queues	10 Hrs.
4.1	Introduction	
4.2	Representation of Stack: Using arrays and Linked Lists	
4.3	Operations on stack: push, pop	
4.4	Applications of Stack: Recursion, Expressions: Infix to postfix, postfix to infix	
4.5	Representation of Queues: Static (Array) and Dynamic (Linked List)	
4.6	Operations on queue: insert, delete	
4.7	Types of queues: Circular queue and Priority queue	
4.8	Real world Applications of queue (Implementation not expected)	
Unit V	Trees	10 Hrs.
5.1	Introduction and terminologies	
5.2	Types of Binary Trees -Rooted Binary Tree, Full Binary Tree, Complete Binary Tree and Skewed Binary Tree, Expression Tree	
5.3	Representation of Trees using arrays and linked lists, traversals (In-order, pre-order, post-order) and operations (Create, Insert, delete, modify, counting nodes etc.)	
5.5	Applications of Binary trees – Expression conversions and evaluation	
5.6	Binary Search Tree (BST): Introduction and Definition, operations on BST (Create, insert node, delete node, search node) and applications	
Unit VI	Graphs	10 Hrs.
6.1	Introduction and Graph terminologies	
6.2	Representation of a Graph -	
6.2.1	Adjacency matrix	
6.2.2	Adjacency list	
6.2.3	Adjacency multi-list	
6.3	Graph Traversals -	
6.3.1	DFS (Depth First Search)	
6.3.2	BFS (Breadth First Search)	
Books		
1.	Horowitz, Ellis and Sahani Sartaj, “Fundamentals of Data Structures”,1 st Edition, Galgotia,1984	
2.	Kamthane, Ashok N., “Introduction to Data Structures using C”,1 st Edition, Pearson,2004	
3.	Bandopadhyaya, S. K. and Dey, K. S. “Data Structures using C”, 1 st Edition, Pearson, 2004	
4.	Srivastava, S. K. and Srivastava, D., “Data Structures using C”,1 st Edition, BPB Publication, 2004	
5.	Gilberg, Richard F. and Forouzan, Behrouz A., “Data Structures: A Pseudocode approach with C”, 2 nd Edition, Cengage Learning, 2007	
6.	Steven S. S, “The Algorithm Design Manual”, 2 nd 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 <u>handwritten write-up</u> of each assignment (Title, Objectives, Problem Statement, Program Outputs, software and Hardware requirements, Date of Completion, Assessment grade/marks and signature of the instructor).		
Guidelines for Assessment The instructor shall carry out internal evaluation of laboratory assignments of 15 marks on a continuous basis throughout the semester. For each lab assignment, the instructor shall assign grade/marks based on parameters with appropriate weightage. Suggested parameters include-timely completion, performance, innovation, efficient codes, code documentation, punctuality and neatness of the write-up etc. A pair of examiners shall conduct end semester examination of 35 marks in the form of practical examination based on journal assignments. Examiners shall ask questions about journal assignments and / or problem statement provided during practical examination to judge understanding of concepts by the students.		

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

Savitribai Phule Pune University Second Year Bachelor of Computer Applications CA - 221 - VSC: C++ Programing		
Teaching Scheme: Practical: 02 Hrs./ Week / Batch	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester: 35 Marks

Course Objectives:

1. To understand the difference between **procedural** and **object-oriented programming paradigms**.
2. To introduce the fundamentals of **object-oriented programming (OOP)** such as classes, objects, constructors, and destructors.
3. To demonstrate advanced OOP features like **function overloading, operator overloading, inheritance, polymorphism, and virtual functions**.
4. To implement robust programs using **exception handling mechanisms**.
5. To apply OOP principles by developing C++ programs that demonstrate real-world problem-solving.

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

- CO1** Compare and contrast **procedural** and **object-oriented** programming paradigms.
- CO2** Use **classes, objects, constructors, and destructors** to create modular C++ programs.
- CO3** Illustrate the use of **function overloading, operator overloading, inheritance, virtual functions, and polymorphism** in C++.
- CO4** Apply **exception handling** mechanisms to manage run-time errors effectively.
- CO5** Demonstrate the use of **object-oriented programming concepts** in solving real-life problems through practical implementations in C++.

Course Contents		
Unit I	Introduction to CPP	2 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 CPP	5 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	6 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 & Destructors	5 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	4 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	4 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	4 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: 6. To understand Object Oriented Programming concepts using the C++. 7. To study principles of data abstraction, inheritance and polymorphism. 8. To learn Virtual functions and polymorphism. 9. 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 Handling 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”, 3 rd Edition, Pearson Education, 2000. 2. T. Gaddis, J. Walters and G. Muganda, “OOP in C++”, 7 th Edition, Pearson Education, 2010. 3. R. Lafore, “Object Oriented Programming in C++”, 3 rd Edition, Galgotia Publications Pvt. Ltd, 2004. 4. Herbert Schildt, “The Complete Reference C++”, 4 th Edition, Tata McGraw Hill, 2014. 5. Walter Savitch, “Problem solving with C++: The Object of Programming, 4 th 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. – 4 Weeks • Preparation of report and presentation – 2 weeks Each group shall submit a report at the end of the semester consisting of Title, Abstract, Rational of the study, problem definition, objectives, outcomes, methodology used, details of field work performed (Field Visits, Interviews, discussions etc.), analysis, SWOT/SWOC, findings, details of proposed solution (Paper design/prototype/mobile App etc.) and conclusions. Students should also submit geo-tagged photographs, audio-video clips etc.		

Guidelines for Assessment

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

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

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

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

BOOKS

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

Savitribai Phule Pune University Second Year Bachelor of Computer Applications 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) 1.7 Protocols 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. <i>Data Communications and Networking</i> – Behrouz A. Forouzan – McGraw-Hill Education 2. <i>Data and Computer Communications</i> – William Stallings – Pearson Education 3. <i>Computer Networks</i> – Andrew S. Tanenbaum, David J. Wetherall – Pearson Education 4. <i>Computer Networks</i> – Atul Kahate – McGraw-Hill Education 5. <i>Data Communications and Computer Networks</i> – Prakash C. Gupta – PHI Learning 6. <i>Computer Networking: A Top-Down Approach</i> – James F. Kurose, Keith W. Ross – Pearson Education 7. <i>Data Communication and Networking</i> – Satish Jain – BPB Publications 8. <i>Fundamentals of Data Communication and Computer Networks</i> – D.L. Varshney – S.K. Kataria & Sons 9. <i>Data Communication & Networks</i> – Achyut S. Godbole – Tata McGraw-Hill 10. <i>Understanding Data Communications and Networks</i> – William A. Shay – Brooks/Cole 11. <i>Introduction to Data Communications and Networking</i> – 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, viśeṣa, 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", 6 th Edition, McGraw- Hill, 2011	
2.	Elmasri and Navathe, "Fundamentals of Database Systems", 7 th Edition, Pearson, 2017	
3.	Ramakrishnan and Gerkhe, "Database Management Systems", 3 rd Edition, Tata McGraw Hill, 2002	
4.	Desai Bipin, "Introduction to Database Management System", 1 st Edition, Galgotia Publication, 2008	
5.	Date, C. J., Kannan and Swamynathan, "An Introduction to Database Systems", 8 th Edition, Pearson, 2006	
6.	Drake and Worsley, "Practical PostgreSQL", O'Reilly Publications, 2002	
7.	Kahate, "Introduction to Database Management Systems", 1 st Edition, Pearson Education, 2004	
8.	Singh, S. K., "Database Systems: Concepts, Design and Application", 2 nd 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 <u>handwritten write-up</u> 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 <u>handwritten write-up</u> 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”, 2 nd Edition, O’Reilly, 2013 2. Payne James, “Beginning Python: Using Python and Python 3.1”, 1 st Edition, Wrox Publication, 2010 3. Dierbach Charles, “Introduction to Computer Science Using Python”, 1 st Edition, Wiley Publication, 2015 4. Balagurusamy E., “Introduction to Computing and Problem-Solving using Python, 1 st Edition, Tata McGraw Hill publication, 2017 5. Mueller John P., “Beginning Programming with Python for Dummies”, 1 st 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 — 4 Weeks • Preparation of report and presentation – 2 weeks Each group shall submit a report at the end of the semester consisting of Title, Abstract, Rational of the study, problem definition, objectives, outcomes, methodology used, details of activities undertaken, analysis, findings, details of proposed solution (paper design/prototype/mobile app etc.) and conclusions. Students should also submit photographs, audio-video clips etc.		

Guidelines for Assessment

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

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

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

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

BOOKS

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

Savitribai Phule Pune University Second Year Bachelor of Computer Applications CA – 251 - SEC: Spreadsheet Applications		
Teaching Scheme Practical: 04 Hrs./ Week / Batch	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End- Semester: 35 Marks
Course Objectives: 1. To know Excel interface, basic and advanced Data Entry and Formatting 2. To understand Excel Formulas and Functions, Charts 3. To learn to automate tasks with Macros and VBA		
Course Outcomes: After successful completion of this course, the learners will be able to - CO1: Navigate and utilize spreadsheet applications effectively for data organization and management CO2: Apply formulas, functions and logical operations to automate tasks. CO3: Analyze and visualize data using charts, pivot tables and conditional formatting CO4: Implement data validation, sorting and filtering for efficient data handling CO5: Develop practical spreadsheet solutions for business scenarios like financial planning, inventory management and project management.		
Guidelines for Instructor's Manual The instructor shall prepare instructor's manual consisting of University syllabus, conduction and Assessment guidelines.		
Guidelines for Student Journal The student shall perform each laboratory assignment and submit the same in the form of a journal. Journal shall have a Certificate, table of contents, and <u>handwritten write-up</u> 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”, 2 nd Edition, John Wiley & Sons, 2022 2. Mc, Fedries and Greg Harvey, “Excel All-in-One for Dummies”, 1 st 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
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 arguments 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”, 1 st Edition, O’Reilly Publication, 2014 2. Montojo, Jason., Campbell, Jennifer and Gries, Paul, “Practical Programming: An Introduction to Computer Science using Python 3”, 2 nd Edition, O’Reilly, 2013 3. Dierbach Charles., “Introduction to Computer Science Using Python”, 1 st Edition, Wiley Publication, 2015 4. Mueller, John P., “Beginning Programming with Python for Dummies”, 1 st 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: 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 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”, 3 rd Edition, Pearson, 2009	
2.	Knight, Kelvin. and Rich, Elaine., “Artificial Intelligence”, 3 rd Edition, McGrawhill Publication, 2017	
3.	Geron, Aurelien., “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow”, 3 rd Edition, 2022	
4.	Goodfellow, Ian., Bengio, Yoshua and Courville, Aaron., “Deep Learning”, MIT press, 2016	
5.	Muller, Andreas., “Introduction to Machine Learning with Python: A Guide for Data Scientists”, 1 st 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”, 3 rd 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”, 3 rd 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: Practical: 04 Hrs./Week/ Batch	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End- Semester: 35 Marks
Course Objectives: 1. To be familiarize with office automation tools for efficient document management, data processing, and communication. 2. To understand tools for word processing, spreadsheets, presentations, and data collection to enhance office productivity. 3. To study tools for collaboration and management of files using cloud-based platforms like Google Drive and OneDrive securely. 4. To learn email etiquette, calendar scheduling, and cyber security for professional office administration.		
Course Outcomes: After successful completion of this course, the learners will be able to CO1: Apply word processing techniques to create, format, and manage professional documents CO2: Use spreadsheet tools for data entry, analysis, visualization, and decision-making. CO3: Design and deliver interactive professional presentations using animations and multimedia integration. CO4: Create and analyze Google Forms for data collection, surveys, and automated feedback management. CO5: Implement email and cloud-based collaboration tools to enhance office communication, scheduling, and document security.		
List of Assignments		
Document Creation and Communication Tools		15 Hrs.
Assignment 1: Understanding CV Formatting and Design: Create a Curriculum Vitae (CV) using Google Docs or MS Word. Apply proper formatting with headings, bold text, and bullet points. Upload the document to Google Drive and share it with your friends as viewers.		
Assignment 2: Automating Personalized Communication with Mail Merge: Use Mail Merge in MS Word to send personalized invitation letters. Prepare an Excel sheet with at least 5 names and email addresses. Merge the data into a formal letter template. Save the final document as PDF, upload it to Google Drive		
Assignment 3: Writing Formal Emails for Professional Communication: Compose a formal email to your professor requesting a meeting using Gmail or Outlook. Attach a Word file as an agenda.		

Spreadsheets for Data Management and Analysis	15 Hrs.
Assignment 4: Data Visualization Using Charts and Conditional Formatting Analyze sales data using charts in MS Excel or Google Sheets. Enter sample sales data (Product, Sales, Revenue, etc.). Create a Bar Chart and Pie Chart to visualize the data. Apply conditional formatting to highlight low sales. Assignment 5: Financial Tracking with Google Sheets Create a monthly expense tracker in Google Sheets. Include columns: Date, Category, Amount, and Total. Use the SUM formula to calculate total expenses. Format the sheet properly.	
Presentations and Multimedia Integration	15 Hrs.
Assignment 6: Enhancing Presentations with Multimedia and Effects Design a 5-slide presentation on "Future of Office Automation" using Google Slides or MS PowerPoint. Include images, animations, and transitions. Add a video or audio clip to enhance the content.	
Online Collaboration and Cloud-Based Tools	15 Hrs.
Assignment 7: Creating and Analyzing Surveys Using Google Forms Create a Google Form to collect event feedback. Include multiple-choice, rating scale, and short-answer questions. Collect at least 10 responses and analyze them in Google Sheets. Assignment 8: Efficient Meeting Scheduling with Google Calendar Schedule a team meeting using Google Calendar. Add title, date, time, and agenda. Invite at least 3 participants and set a reminder. Assignment 9: File Management and Collaboration in Google Drive Organize and share files in Google Drive. Create a folder named "Office Automation Project" and upload at least 3 different files (Doc, Sheet, Slide)	
Books	
1. Randy, Nordell, "Microsoft Office 365: In Practice", 1st Edition, McGraw-Hill Publication, 2023 2. Steve Tudor, "Excel 2023: The Most Updated Guide to Master Microsoft Excel" 3. Richard Wilson, "Google Forms and Google Sheets for Beginners" 4. Poatsy, Mary Anne., and Davidson, Jason, "Microsoft Word 2021 and 365 for Beginners", 1st Edition, Pearson Publication, 2022	

Abbreviations

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

Savitribai Phule Pune University, Pune
Faculty of Commerce and Management

Batchelor of Computer Application
(BCA)

Revised Curriculum (2024 Pattern as per NEP-2020)
w.e.f from Academic Year 2026-27

TYBCA (Management) Semester V						
Course Type	Course	Course Code	Course Title	Credits		Hours / Week
				Theory	Practical	
Major Mandatory (10)	Major Mandatory 11	MJ-301-JP	Java Programming	4	-	4
	Major Mandatory 12	MJ-302-UIX	User Interface and User Experience (UI-UX) Design	4	-	4
	Major Mandatory 13	MJ-303-JPP	Computer Laboratory based on Java Programming	-	2	4
	Major Mandatory 14	MJ-304-UIXP	Computer Laboratory based on UI-UX Design	-	2	4
Major Elective	Major Elective 1	MJE-301-ECC	Essentials of Cloud Computing	2	-	2
Minor	Minor 4	MN-301-SE	Software Engineering	4	-	4
Vocational Skill Development Course (VSC)	Vocational Skill Development Course (VSC) (Practical)	VSC-301-ES	Entrepreneurship Essentials	-	2	4
Field Projects (FP)/ Community Engagement and Service corresponding to the Major (CEP)	Project	FP-301-MM	Project based on Major Mandatory	-	2	4
Total				14	8	

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/ Week
5	MJ-301-JP	Major Mandatory 11	Java Programming	4	4

Course Objectives	
1	To understand the fundamentals of Java programming, syntax, program structure, and features of Java.
2	To learn object-oriented programming concepts such as classes, objects, inheritance, polymorphism, abstraction, and interfaces.
3	To develop programming skills using packages, exception handling, multithreading, and other advanced Java concepts.
4	To apply collection framework concepts in Java applications.
5	To design GUI-based and event-driven applications using Swing & JDBC.

Course Outcome	
CO1	Explain the fundamentals of Java programming including syntax, program structure, data types, arrays, strings, and features of Java
CO2	Apply object-oriented programming concepts such as classes, objects, inheritance, polymorphism, abstraction, and interfaces in Java applications
CO3	Develop Java programs using packages, exception handling, multithreading, and other advanced Java programming concepts.
CO4	Implement collection framework concepts in Java applications for problem solving.
CO5	Design GUI-based and event-driven applications using Swing & JDBC components.

Unit	Title and Contents	No. of Lecture Hours
1	1.1 Introduction to Java 1.1.1. Why Java 1.1.2. Programming Paradigms 1.1.3. Java vs C/C++ 1.1.4. Features of Java 1.2 Basics of Java 1.2.1. Structure of Java Program 1.2.2. Tokens, Statements, Data Types 1.2.3. Variables, Constants, Operators, Type Casting 1.2.4. Execution Process, JVM & JDK Tools 1.2.5. Command Line Arguments 1.3 Arrays and Strings 1.3.1. Single & Multidimensional Arrays 1.3.2. String, StringBuffer & StringTokenizer 1.4 Packages and Wrapper Classes 1.4.1. java. lang and java.util Packages 1.4.2. Wrapper Classes (Integer, Float, Double, Character, Boolean,etc.)	9

2	2.1 Classes and Objects 2.1.1 Classes, Objects, and Constructors 2.1.2. Methods and Recursion 2.1.3. Method/Constructor Overloading 2.2 Java Keywords -new, this, static 2.3 Inheritance and Polymorphism 2.3.1 Inheritance and Types 2.3.2. Method Overriding 2.3.3. Dynamic Method Dispatch 2.3.4 super Keyword 2.4 Abstraction and Encapsulation 2.4.1 Abstraction 2.4.2 Encapsulation 2.4.3 Abstract Classes 2.4.4 Interfaces 2.5 Garbage Collector	9
3	3.1 Packages 3.1.1 Built-in and User-Defined Packages 3.1.2. Import Statements 3.1.3Access Modifiers 3.2 Exception Handling 3.2.1 Exception and Error 3.2.2 Built-in Exceptions 3.2.3 try, catch, throw, throws and finally 3.2.4 User Defined Exceptions 3.3 Multithreading 3.3.1 Introduction to Multithreading 3.3.2 Thread Life Cycle ,Methods 3.3.3 Synchronization 3.3.4 wait(), notify(), notifyAll() Methods	8
4.	4.1 Collection Framework 4.1.1 Introduction to Collection Framework 4.1.2 Interfaces: Collection, List, Set, Map 4.1.3 Navigation Interfaces: Enumeration, Iterator, ListIterator 4.1.4 List Interface and Classes: ArrayList, LinkedList, Vector 4.1.5 Set Interface and Classes: HashSet,LinkedHashSet,TreeSet 4.1.6. Map Interface and Classes: HashMap, LinkedHashMap, TreeMap	9

5.	5.1 Swing (JFC) 5.1.1 Introduction to Swing 5.1.2. Event Handling, Listeners & Adapter Classes 5.1.3. Swing Components – JFrame, JLabel, JTextField, JTextArea, JButton, JCheckBox, JRadioButton, JComboBox, JTable, JScrollPane, JTabbedPane 5.2 JDBC (Java Database Connectivity) 5.2.1 Introduction, Architecture & Drivers 5.2.2 JDBC Interfaces & Database Connectivity 5.2.3 CRUD Operations using JDBC	10
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Reference Material:

Reference Books

Sr. No.	Title of the Book	Author/s	Publication	Place
1	Programming with JAVA	E Balgurusamy	McGraw Hill Education	New Delhi, India
2	The Complete Reference – JAVA	Herbert Schildt	McGraw Hill	New York, USA
3	Head First Java	Kathy Sierra and Bert Bates,	O'Reilly Media	Sebastopol, California, USA
4	Java Programming and Object-Oriented Application Development	R.A. Johnson	Cengage Learning	Boston, Massachusetts, USA

Web Link:

1. <https://www.geeksforgeeks.org/java>
2. <https://www.tutorialspoint.com/java>
3. <https://www.w3schools.com/java>
4. <https://www.programiz.com/java>

Text Books:

1. Programming with Java – E. Balagurusamy
2. Java: The Complete Reference – Herbert Schildt
3. Programming in Java – Sachin Malhotra & Saurabh Choudhary
4. Java Programming – Yashavant Kanetkar, BPB Publications

MOOC Courses:

1. Programming in Java Indian Institute of Technology Kharagpur
2. Java Programming Masterclass, Udemy
3. Object Oriented Programming in Java, Coursera

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/Week
5	MJ-302-UIX	Major Mandatory (12)	User Interface and User Experience (UI-UX) Design	4	4

Course Objectives	
1	To introduce students to the fundamentals of User Interface (UI) and User Experience (UX) Design.
2	To develop understanding of user-centered design principles.
3	To familiarize students with wireframing, prototyping, and usability concepts.
4	To enable students to design effective and user-friendly digital interfaces.
5	To develop practical skills using modern UI/UX design tools.

Course Outcome	
CO1	Understand the fundamentals and importance of UI and UX Design.
CO2	Apply user-centred design principles in interface development.
CO3	Design wireframes, mockups, and prototypes for digital applications.
CO4	Evaluate usability and accessibility of user interfaces.
CO5	Develop basic UI/UX projects using industry-standard tools.

Unit	Title and Contents	No. of Lecture Hours
1	Unit 1 – Introduction to UI and UX Design: 1.1.1 Introduction to UI and UX 1.1.2 Difference between UI and UX 1.1.3 Rules and Skills of UI/UX 1.1.4 Fundamental Principles of UI/UX Design 1.1.5 Future Scope and Demand of UI/UX 1.1.6 Tools for UI/UX Design 1.1.7 Overview of Design Thinking	8
2	Unit 2 – UX Design and Research 2.1.1 Introduction to UX Design 2.1.2 User-Centered Design (UCD) 2.1.3 Mental Models 2.1.4 User Personas and Empathy Mapping 2.1.5 User Journey and User Flow 2.1.6 Content Organization Techniques 2.1.7 UX Research Methods 2.1.8 Surveys, Interviews, and Observation 2.1.9 Eye Tracking and Clickstream Analysis 2.1.10 Competitor Analysis	9
3	Unit 3 – Wireframing and Prototyping 3.1.1 Wireframing Concepts 3.1.2 Prototyping Techniques 3.1.3 Prototype Fidelity (Low/Medium/High) 3.1.4 Paper and Digital Prototypes 3.1.5 Mockups and Interactive Design 3.1.6 Information Architecture 3.1.7 Grid and Layout Systems 3.1.8 Navigation Design 3.1.9 Mobile and Responsive Design 3.1.10 Design Tools: Figma, Adobe XD, Sketch, Canva	10
4.	Unit IV- Visual Foundations of UI/UX 4.1.1 Typography and Color Theory 4.1.2 Layout and Grid Systems 4.1.3 Visual Hierarchy 4.1.4 Responsive Design 4.1.5 Accessibility Principles	9

5	Unit V- Evaluation Methods and Design Validation 5.1.1 Usability Heuristics 5.1.2 Usability Testing 5.1.3 A/B Testing and Heat maps 5.1.4 UX Laws and Design Validation 5.1.5 UI/UX Case Studies	9
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Reference Books

Reference Book				
Sr. No.	Title	Author	Publication	Year, Edition
1	A Project Guide to UX Design: For User Experience Designers in the Field or in the Making	Russ Unger, Carolyn Chandler	New Riders; 2	edition, 2012
2	The Design of Everyday Things	Don Norman	Basic Books; 2	edition, 2013
3	UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication	Everett N. McKay	Morgan Kaufmann; Illustrated.	edition, 2013
4	Richard Helm and John Vlissides, Design Patterns: Elements of Reusable Object - Oriented Software	Dr. Erich Gamma, Ralph Johnson	Pearson	2008

Other Learning Material E- Resource:

Figma Official Learning Resources – <https://www.figma.com/resources/learn-design/>

Adobe XD Tutorials – <https://helpx.adobe.com/xd/tutorials.html>

Google Material Design Guidelines – <https://material.io/design>

Nielsen Norman Group (NNG) – <https://www.nngroup.com>

Interaction Design Foundation – <https://www.interaction-design.org>

Coursera UI/UX Design Courses – <https://www.coursera.org>

UX Collective Articles – <https://uxdesign.cc>

W3Schools Responsive Web Design – <https://www.w3schools.com>

Hotjar Learning Resources – <https://www.hotjar.com>

Canva Design School – <https://www.canva.com/designschool/>

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/Week
5	MJ-303-JPP	Major Mandatory 13	Computer Laboratory based on Java Programming	2	4

Course Objectives	
1	To understand the fundamentals of Java programming, syntax, program structure, and features of Java.
2	To understand and implement object-oriented programming concepts using Java.
3	To develop programming skills using Packages, Exception Handling, and Multithreading concepts in Java.
4	To understand and implement Java Collection Framework concepts techniques for developing efficient Java applications.
5	To design GUI-based Java applications using Swing, event handling, and JDBC.

Course Outcome	
CO1	Write Java programs using fundamental data types, arrays, and string handling techniques.
CO2	Implement object-oriented programming concepts such as inheritance, polymorphism, abstraction, and interfaces in Java.
CO3	Apply packages, exception handling, and multithreading concepts to build robust Java applications.
CO4	Utilize Java Collection Framework classes to design efficient data-handling programs.
CO5	Design Java-based graphical user interface applications using Swing components, layouts, graphics, event handling, and JDBC connectivity..

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, Code, Output

Assignment No.	List of Assignments
1	Assignment 1 Write a program to convert the temperature (a) from Celsius to Fahrenheit and (b) from Fahrenheit to Celsius. (Hint: $F = (9C/5 + 32)$) Assignment 2 Write a program to swap value of two variables without using arithmetic operators and third variable. The marks obtained by a student in 5 different subjects are input through the keyboard. The student gets a division as per the following rules: Percentage above or equal to 75 – Honors Percentage above or equal to 60 – First Division Percentage between 50 and 59 – Second Division Percentage between 40 and 49 – Third Division Percentage less than 40 – Fail Assignment 3. Write a program to calculate the division obtained by the student. Assignment 4. Write a menu driven program in Java, which consists following option? · To find the second biggest using array, to smallest of N numbers using array Assignment 5 Create a package named Maths. Define class MathsOperations with static methods to find the maximum and minimum of three numbers. Create another package Stats. Define class StatsOperations with methods to find the average and median of three numbers. Use these methods in main to perform operations on three integers accepted using command line arguments.

2	Assignment 1: Class using constructor & method overloading with passing and returning objects from method. Assignment 2: Demonstration of new, this, static, keyword and finalize method. Assignment 3: Inheritance & polymorphism using super and final keywords. Assignment 4: Abstract class, interface & interface inheritance in java. Assignment 5: Create an interface for an Employee Management System to calculate salary for different employee types.
3	Assignment 1: User Defined Package and Access Specifiers Assignment 2: Exception Handling using try-catch-finally and User Defined Exception Assignment 3: Multithreading using Thread Class and Synchronization Assignment 4: Thread Communication using wait (), notify (), and notifyAll () Assignment 5 : Demonstration of Thread Life Cycle Methods
4.	Assignment 1: Write a Java program to store and display student names using ArrayList. Assignment 2: Write a program that shows the use of LinkedList class. Assignment 3: A college wants to develop a Student Management System to store and manage student records. The system should: 1. Store student details (Roll No, Name, Course). 2. Display all student records. Assignment 4: Write a program which shows the use of HashSet and Iterator. Assignment 5: Write a Java program to sort keys using TreeMap.
5.	Assignment 1: Write a Java program using Swing and JDBC to insert student records into MySQL database. Assignment 2: Write a program to demonstrate basic components like Label, TextField, TextArea, Button, Checkbox, and RadioButton in a single Frame. Assignment 3: Write Java program to create the following GUI using Swing Components. Assignment 4: Write a Java program using Swing and JDBC to search book details from library database. Assignment 5: Develop a Java Swing application for an Employee Management System with buttons: Add, Update, Delete, and Search employee records using JDBC

Reference Material:**Reference Books**

Sr. No.	Title of the Book	Author/s	Publication	Place
1	Programming with JAVA	E Balgurusamy	McGraw Hill Education	New Delhi, India
2	The Complete Reference – JAVA	Herbert Schildt	McGraw Hill	New York, USA
3	Head First Java	Kathy Sierra and Bert Bates,	O'Reilly Media	Sebastopol, California, USA
4	Java Programming and Object-Oriented Application Development	R.A. Johnson	Cengage Learning	Boston, Massachusetts, USA

Web Link:

5. <https://www.geeksforgeeks.org/java>
6. <https://www.tutorialspoint.com/java>
7. <https://www.w3schools.com/java>
8. <https://www.programiz.com/java>

Text Books:

5. Programming with Java – E. Balagurusamy
6. Java: The Complete Reference – Herbert Schildt
7. Programming in Java – Sachin Malhotra & Saurabh Choudhary
8. Java Programming – Yashavant Kanetkar, BPB Publications

MOOC Courses:

4. Programming in Java Indian Institute of Technology Kharagpur
5. Java Programming Masterclass, Udemy
6. Object Oriented Programming in Java, Coursera

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/ Week
5	MJE-304-UIXP	Major Mandatory 14 (Practical)	Computer Laboratory based on UI-UX Design	2	4

Course Objectives	
1	To build a foundational understanding of UI/UX principles, design rules, and their evolving scope in technology and industry.
2	To train students in user-centered design methods — including persona mapping, empathy mapping, storyboarding, and scenario creation — for developing effective digital products.
3	To apply core visual design concepts such as Gestalt principles, color theory, typography, and accessibility guidelines to create intuitive, inclusive interfaces.
4	To develop hands-on proficiency in wireframing, prototyping, and responsive design using industry-standard tools (e.g., Figma, Adobe XD), grounded in real-world case studies and collaborative project work.

Course Outcome	
CO1	Outline the key stages of the UI/UX design process, from research and ideation to prototyping and testing.
CO2	Apply various visual design principles — including layout, color, typography, and iconography — to design elements.
CO3	Develop a consistent visual theme and style that aligns with a product's identity and user experience goals.
CO4	Design effective, engaging, and user-centered screen-based interfaces for digital products.

Guidelines for Instructor's Manual

The instructor shall frame at least 10 assignments. Instructor's manual consisting of University syllabus, conduction & Assessment guidelines is to be developed.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal.

Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion.

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing student's programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be retained with program prints.

Guidelines for Assessment

Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor will assign grade/marks based on parameters such as timely completion, understanding, neatness etc. with appropriate

List of Assignments

1. Apply 5 fundamental UI/UX principles (consistency, feedback, simplicity, visibility, accessibility) to redesign a basic form
2. Create 2 personas for an e-commerce app in Figma.
3. Design a storyboard showing a student using a university portal.
4. Build an empathy map for a food delivery app user.
5. Create a homepage layout applying Gestalt principles, color theory, and typography.
6. Redesign a form page ensuring accessibility (contrast, font size, alt text).
7. Design a registration form in Adobe XD with clear microcopy (error messages, hints, button labels).
8. Redesign a news website homepage in Adobe XD considering visual impairments (high contrast mode, larger fonts, ARIA labels).
9. Create a navigation flow for a shopping app. like Home → Product → Cart → Payment → Confirmation.
10. Design a responsive layout for a news page.

Reference Books

Reference Book				
Sr. No.	Title	Author	Publication	Year, Edition
1	A Project Guide to UX Design: For User Experience Designers in the Field or in the Making	Russ Unger, Carolyn Chandler	New Riders; 2	edition, 2012
2	The Design of Everyday Things	Don Norman	Basic Books; 2	edition,

				2013
3	UI is Communication: How to Design Intuitive, User Centered Interfaces by Focusing on Effective Communication	Everett N. McKay	Morgan Kaufmann; Illustrated.	edition, 2013
4	Richard Helm and John Vlissides, Design Patterns: Elements of Reusable Object - Oriented Software	Dr. Erich Gamma, Ralph Johnson	Pearson	2008

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Figma Official Learning Resources – <https://www.figma.com/resources/learn-design/>
 Adobe XD Tutorials – <https://helpx.adobe.com/xd/tutorials.html>
 Google Material Design Guidelines – <https://material.io/design>
 Nielsen Norman Group (NNG) – <https://www.nngroup.com>
 Interaction Design Foundation – <https://www.interaction-design.org>
 Coursera UI/UX Design Courses – <https://www.coursera.org>
 UX Collective Articles – <https://uxdesign.cc>
 W3Schools Responsive Web Design – <https://www.w3schools.com>
 Hotjar Learning Resources – <https://www.hotjar.com>
 Canva Design School – <https://www.canva.com/designschool/>

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/ Week
5	MJE-301-ECC	Major Elective 1	Essentials of Cloud Computing	2	2

Course Objectives	
1	To introduce the basics of Cloud Computing and its Architecture.
2	To give Insights into Cloud Service Models and Deployment Models.
3	To provide knowledge on virtualization technologies.
4	To understand pricing and billing of different Cloud Platforms and Tools
5	To impart the knowledge on different Cloud Platforms.

Course Outcome	
CO1	Explain the fundamental concepts of Cloud Computing, Docker, and Containerization.
CO2	Analyze various Cloud Service Models (IaaS, PaaS, SaaS) and Deployment Models.
CO3	Apply virtualization concepts using hypervisors, virtual machines, VMware, Microsoft Hyper-V, and Open-Source Virtualization Managers.
CO4	Describe Cloud Storage methods and relate Cloud Computing to SOA, SLA management, and cloud bursting strategies.
CO5	Compare leading Cloud Platforms — AWS, GCP, and IBM Cloud — based on their features and services..

Unit	Title and Contents	No. of Lecture Hours
1	Introduction to Cloud Computing 1.1 Introduction to Cloud Computing 1.2 Cloud Computing vs. Cluster Computing vs. Grid Computing 1.3 Characteristics, Pros and Cons of Cloud 1.4 Introduction to Dockers 1.5 Introduction to Container	05
2	Cloud Service Models and Deployment Models 2.1 Cloud Service Models - IAAS, PAAS, SAAS & its Comparison 2.2 Cloud Deployment Models-Public, Private, Hybrid, Community 2.3 XAAS- Anything as a Service – Storage as a service, Network as a Service, Database as a Service	07

3	Virtualization 3.1. Introduction to Virtualization concept & Hypervisors 3.2. Core Types of Virtualization, Pros and Cons of Virtualization 3.3. Machine Image, Virtual Machine (VM) 3.4. Xen: Para virtualization, VMware: Full Virtualization 3.5. Microsoft Hyper-V 3.6. Open-Source Virtualization Manager	08
4.	Cloud Storage Economics & Management 4.1. Cloud Storage Types: Block, File, Object Storage 4.2. Web Services: SOAP and REST 4.3. Relating SOA and Cloud Computing. 4.4. Service Level Agreement (SLA), Billing, Pricing, and Support 4.5. Cloud Management Tools	05
5	Fundamentals of Cloud Platforms 5.1. Commercial cloud computing Infrastructures. 5.2. Amazon Web Services (AWS) 5.3. Google Cloud Platform (GCP) 5.4. Microsoft Azure (M. Azure) 5.5. Sales Force 5.6. IBM Cloud	05

Reference Material:

Sr. No.	Title of the Book	Author/s	Publication
1	Cloud Computing Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttin	
2	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi	McGraw Hill Education (India) Private Limited
3	Cloud Computing Web –Based Applications that change the way you work and Collaborate Online	Michael Miller	Pearson
4	Cloud Computing for Dummies	Judith Hurwitz, Robin Bloor, Marcia Kaufman, FernHalper	

Reference Books:

Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,
Cloud Computing: Automating the Virtualized Data Center
Cloud Computing by Dr. Kumar Saurabh, Wiley–India
Cloud computing: A practical approach by Anthony T. Velte, Tata
McGraw-Hill

Other Learning Material E- Resource:

<http://www.cloudcomputingpatterns.org/>
<http://whatiscloud.com>
www.w3schools.com

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/Week
5	MN-301-SE	Minor 4	Software Engineering	4	4

Course Objectives	
1	To understand the concept of software engineering and its relevance.
2	To understand Requirement Engineering concepts and prepare SRS documents using IEEE standards.
3	To understand Object Oriented concepts and to design static and dynamic UML diagrams.
4	To Understand basic concepts of software project management and software testing
5	To understand Agile Project Management concepts, Agile methodologies, tools, and team practices for effective software project development and management.

Course Outcome	
CO1	Understand fundamental concepts, principles, and relevance of Software Engineering in software development.
CO2	Understand software requirements and develop Software Requirement Specification (SRS) documents using IEEE standards.
CO3	Apply object oriented concepts, methods and UML diagrams with project specifications.
CO4	Understand Agile model , principles and role in software project development.
CO5	Apply software testing techniques in software development.

Unit	Title and Contents	No. of Lecture Hours
1	Introduction to Software Engineering 1.1 Software - Definition, Characteristics of software Types of Software - Application Software, System software 1.2 Software Engineering: Definition, Need 1.3 Software Development Life Cycle 1.4 SDLC Models: Waterfall Model, Prototype, Spiral, RAD (Rapid Application Development), JAD (Joint Application Development)	7

2	Requirement Engineering and SRS 2.1 Requirement: Definition Types of requirement: Functional and Non-functional 2.2. Requirement gathering techniques 2.3 Requirement Engineering 2.6 Software Requirement Specification (SRS) (IEEE format)	7
3	Requirements Modelling-UML 3.1. Object oriented concepts 3.2. Difference between SSAD and OOAD 3.3. Object Oriented Methodologies: Booch Methodology and Rumbaugh Methodology (OMT) 3.4. Introduction of Unified Modelling Language (UML) & Notations 3.5. UML Diagrams 3.5.1. Use case Diagram 3.5.2. Class Diagram 3.5.3. Object Diagram 3.5.4. Activity Diagram 3.5.5. Interaction Diagram: Sequence and Collaboration 3.5.6. Component and Deployment Diagram	16
4	Introduction to Agile 5.1 Introduction to Agile 5.2 Agile Life Cycle 5.3 Agile Manifesto 5.4. Agile Principles 5.5 Types of Agile 5.6. Agile Team Structure and Roles	6
5	Software Testing 5.1. Introduction to Software Testing: Definition, Need, Importance 5.2. Software Quality Concepts: 5.3. Software Defects and Failures 5.4. Testing Principles 5.5 Verification vs Validation 5.6. Testing Techniques: White box and Black box 5.7. System Testing Levels	9

Reference Material:

Reference Books

Sr. No.	Title of the Book	Author/s	Publication
1	Software Engineering : A Practitioner's Approach	Roger S. Pressman, McGraw hill	International Editions 2010(Seventh Edition)
2	Software Engineering	K. K. Aggarwal and Yogesh Singh	New Age International Publisher

3	Software Engineering	Pankaj Jalote	Wiley India Pvt. Ltd
4	The Unified Modelling Language User/Reference Guide	Grady Booch, James Rumbaugh	Pearson Education Inc
5	Software Engineering	Dr. Nasib Sing Gill	Khanna Book Publishing
6	Agile Project Management for Dummies	Mark C. Layton	O'Reilly Media

Other Learning Material E- Resource:

Websites:

<https://www.geeksforgeeks.org/software-engineering/software-engineering>

https://www.tutorialspoint.com/software_engineering/software_engineering_overview.htm

MOOCs / Online Courses:

- NPTEL Courses (Software Engineering, UML, Agile, Project Management)
- SWAYAM Platform
- Coursera (Software Engineering Specializations)
- NOC: Software Engineering, IIT Kharagpur Prof. Rajib Mall

Semester V					
Semester No.	Type of Course	Course Code	Course Title	Credits	Hours/Week
5	Vocational Skill Development Course(VSC)	VSC – 301-ES	Entrepreneurship Essentials	2	4

Course Objectives	
1	Develop entrepreneurial mind-set and attributes; entrepreneurial skill sets for venture creation and entrepreneurial leadership
2	Apply process of problem-opportunity identification and feasibility assessment through developing a macro perspective of the real market, industries, domains and customers while using design thinking principles to refine and pivot their venture idea.
3	Analyse Customer and Market segmentation, estimate Market size, develop and validate Customer Persona.
4	Initiate Solution design, Prototype for Proof of Concept.
5	Understand MVP development and validation techniques to determine Product-Market fit
6	Craft initial Business and Revenue models and understand basics of financial planning

Course Outcome	
CO1	Demonstrate an entrepreneurial mind-set and appreciate the concepts of entrepreneurship, cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership
CO2	Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution
CO3	Build Prototype for Proof of Concept and validate MVP of their practice venture idea
CO4	Analyse and refine business models to ensure sustainability and profitability
CO5	Create a basic business plan and feasibility analysis to assess the financial viability of a venture
CO6	Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

Unit	Title and Contents	No. of Lecture Hours
1 Entrepreneurship Fundamentals and Problem-Opportunity Identification	1.1 Meaning and concept, attributes and mind-set of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. 1.2 Understanding and analysing the macro-Problem and Industry perspective, technological, socio economic and urbanization trends and their implication on new opportunities. 1.3 Aligning passion, identifying and defining problem using Design thinking principles. Analysing problem and validating with the potential customer.	10
2 Customer Discovery, Ideation and competition mapping	2.1 Understanding customer, customer segmentation, creating and validating customer personas. 2.2 Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Iterating problem-customer fit. 2.3 Examining ideation techniques and generating solution ideas. Competition and Industry trends mapping for assessing market sizing - initial opportunity.	10
3 Prototyping & Basics of Business Model	3.1 Developing Problem-solution fit in an iterative manner. Understanding prototyping and MVP. 3.2 Developing a feasibility prototype with differentiating value, features and benefits. Initial testing for proof-of-concept and iterate on the prototype. 3.3 Introduction to revenue model and its types, Lean approach and basics of financial management.	10

Reference Material:

Reference Books

Sr. No.	Title of the Book	Author/s	Publication	Place
1	Entrepreneurship (11th Edition)	Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha	McGraw Hill	New York
2	The Lean Startup: How Today's Entrepreneurs Use Continuous	Eric Ries	Crown Business	New York

	Innovation to Create Radically Successful Businesses			
3	Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers	Alexander Osterwalder & Yves Pigneur	John Wiley & Sons	Hoboken, New Jersey
4	Start with Why	Simon Sinek	Penguin Books Limited	London
5	Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	Harper Business	New York
6	The Dolphin and the Shark: Stories on Entrepreneurship	Namita Thapar	Penguin Books Limited	New Delhi
7	Effectuation: Elements of Entrepreneurial Expertise	Saras D. Sarasvathy	Elgar Publishing Ltd	Cheltenham, UK

This Course will be executed in collaboration with SPPU's Innovation, Incubation & Linkages and Wadhavani Foundation.

Semester V					
Semester No.	Course Code	Type of Course	Course Title	Credits	Hours/Week
5	FP-301-MM	Project	Project based on Major Mandatory	2	4

Course Objectives	
1	Enhance programming skills, software development methodologies and proficiency in relevant technologies/tools
2	Encourage creative thinking, increase problem solving and innovation in designing solutions that meet specified requirements and constraints
3	Improve presentation skills by effectively communicating project goals, methodologies, results and conclusions to peers, faculty, and potentially external stakeholders
4	Foster teamwork and collaborative skills through group-based project work, including division of tasks, coordination, and communication

Course Outcome	
CO1	Apply knowledge of software engineering principles and methodologies in designing and implementing the project
CO2	Demonstrate the ability to develop a functioning software application or solution that meets specified requirements and objectives
CO3	Design comprehensive documentation that includes project requirements, design specifications, implementation details, testing strategies, and user manuals
CO4	Create and Design innovative original software solutions that meet specific requirements and constraints, fostering creativity and problem-solving skills.

General Guidelines for Project:

1. Project Selection:

Students can choose any specialization/technology or a combination for their project.
Topics must align with industry trends and academic relevance.
Consult with internal guides for topic approval and feasibility.

2. Project Execution:

Follow the Software Development Life Cycle (SDLC) for systematic execution.
Use appropriate tools and technologies for design, implementation, and testing.
Ensure proper documentation, including diagrams, screenshots, and references.

3. Evaluation Criteria:

Innovation and Problem Definition: 15%
Implementation and Technical Complexity: 30%
Resource Utilization and Security: 15%
Performance and Optimization: 15%
Documentation and Presentation: 25%

4. Timeline and Milestones:

Week 1-2: Topic Selection & Approval

Week 3-4: Literature Review & Requirement Analysis

Week 5-8: Environment Setup & Initial Development

Week 9-12: Implementation & Testing

Week 13-15: Final Documentation & Presentation

5. Presentation:

Regular interval presentations to review progress.

Final presentation to peers, faculty, and external stakeholders.

6. Documentation: Follow a structured format with clear sections.

7. Presentation: Use visuals (diagrams, charts) to enhance understanding.

8. Ethical Considerations: Ensure compliance with ethical guidelines.

9. Teamwork: Collaborate effectively and divide tasks among team members.

10. Development (Java Programming/UI-UX)

Project Requirement Details	Details
Technology Stack Use frameworks like java,JDBC,SQL	Use Technology frameworks like Java, HTML,CSS,js
Database Implement SQL or MYSQL databases	Database Implement SQL databases

11.INDEX

Chapter	Content	Page Number
Chapter 1	Introduction	
1.1	Problem Statement	
1.2	Objectives	
1.3	Scope	
1.4	Modules	
Chapter 2	Design	
2.1	System Architecture	
2.2	UML Diagram	
2.3	Database Design	
Chapter 3	Implementation	
3.1	Frontend Development	
3.2	Backend Development	
3.3	Database Tables	
Chapter 4	Testing	
4.1	Test Cases	
4.2	Results	
CHAPTER 5	USER MANUAL	
4.1	User Interface Screens (Input)	
4.2	Output Screens with data	

4.3	Data Reports	
Chapter 5	Conclusion	
5.1	Summary	
5.2	Limitations and Bibliography	
5.2	Future Scope and Enhancements	
Chapter 6	References	