Faculty of Science & Technology
Savitribai Phule Pune University, Pune

Syllabus for
FY M. SC. (Computer Applications)
(2023 Pattern)
(With effect from A. Y. 2023-24)

Preamble

The field of computing is rapidly 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), 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 PG programmes vide its circular No. 122/23.

The Ad-hoc Board of Studies in Computer Applications has prepared a structure for M. Sc. (Computer Applications) with following features

- The structure of the course is designed as per National Education Policy (NEP) 2020 and is in line with University circular 122/23.
- The total credits offered for the two years (level 6.0 and level 6.5) with four semesters are 88 with 22 credits assigned for each of the four semesters.
- The programme has Multiple Entry/exit feature.
  Various types of courses includes - Mandatory Core (MC) – Theory and Lab courses, Mandatory Elective (ME) – Theory and Lab courses, Research Methodology, On-job Training (OJT)/Field Project (FP) and Research Project (RP)

I am thankful to Hon. Vice-Chancellor Prof. Dr. S W. Gosavi, Hon. Dean of FoS&T, Prof. Dr. M G Chaskar for their guidance. I am thankful to all board members Prof. Dr. Rahul Patil, Prof. Dr. Razak Sayyad, Mr. Atul Kahate and Mr. Milnd Tanksale for their valuable inputs as well as the teachers from affiliated colleges for their active participation in preparing the draft syllabus.

Prof. Dr. S S Sane
Chairman,
Ad-hoc Board of Studies in Computer Applications
Faculty of Science and Technology, SPPU

M.Sc. (Computer Applications)

Objectives

The objective of the Program is to produce trained software professionals with hands-on experience on state-of-the art technologies who will be able to handle challenges in IT industry. The objectives of M.Sc. (Computer Applications) program are: -

- To produce knowledgeable and skilled human resources that is employable in IT and ITES.
- To impart knowledge required for planning, designing and building Complex Application SoftwareSystems as well as to provide support for automated systems or applications.

M.Sc. (Computer Applications) Program is of Two Years duration with four semesters. It is a Full- Time post graduate Degree Program. The program is based on credit system comprising of total 88 credit points.

It is believed that the proposed syllabus as part of the credit-based system will bring a qualitative change in the way M.Sc. (Computer Applications) is taught, which will offer a more enriched learning experience. It aims to provide students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer applications, systems and technology on people and society. The students shall develop self and life-long learning skills.

Eligibility

(a) Bachelor Degree in Science/Technology/Engineering OR
(b) Bachelor of Computer Applications (B.C.A.) OR
(c) B.Sc.(Computer Science) OR
(d) Bachelor of Computer Science (B.C.S.) OR
(e) B.Sc.(Information Technology) OR
(f) B.Sc.(Data Science) OR
(g) B.Sc.(Cyber and Digital Science) OR
(h) B.Sc. (Cyber Security) OR
(i) B.Sc. (Cloud Computing) OR
(j) Bachelor of Engineering(BE/B.Tech) in Computer Engg/Computer Science & Engg./ Computer Science and Design/ Information Technology/Electronics and Telecommunication/AI and Data Science/AI and Machine Learning/ equivalent OR
(k) B. Voc. in Software Development/ Information Technology OR
(l) B.Sc. with Computer Science as Principal Subject OR
(m) General B.Sc. with Computer Science as one of the subject at TYBSc level Programme

Programe Outcomes:

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

PO 1: Demonstrate understanding of fundamental and advance concepts in emerging areas

PO 2: Design and develop innovative computer applications.

PO 3: Analyze existing research reported in the literature

PO 4: Propose alternate solutions by undertaking research work.

PO 5: Create efficient, reliable, readable and maintainable code.

PO 6: Demonstrate a deeper understanding of the chosen domain.

PO 7: Select appropriate method to solve the given problem

PO 8: Explain complex technical concepts clearly and effectively, both in written and oral forms.

PO 9: 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.

STRUCTURE FOR M. Sc. (Computer Applications) 2023 Pattern
AS PER NEP GUIDELINES

Abbreviations

TH: Theory
CE: Continuous Evaluation
CA: Computer Applications
ME: Mandatory Elective
OJT/FP: On-job Training / Field Project
PR: Practical
EE: End Semester Examination
MC: Mandatory Core
RM: Research Methodology
RP: Research Project

SEMESTER I

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.0	MC	CA 501 MJ	Database Systems and SQL	04	--	30	70	100	04	--	**04**
		CA 502 MJ	Python Programming and Data Structures	04	--	30	70	100	04	--	**04**
		CA 503 MJ	Operating Systems	02	--	15	35	50	02	--	**02**
		CA 504 MJP	Lab course Based on CA 501 MJ & CA 503 MJ	--	04	15	35	50	--	02	**02**
		CA 505 MJP	Lab course based on CA 502 MJ	--	04	15	35	50	--	02	**02**
	ME	CA 510A MJ	Java Programming	02	--	15	35	50	02	--	**02**
		CA 511 MJP	Lab Course based on CA 510A	--	04	15	35	50	--	02	**02**
		OR									
		CA 512B MJ	Cloud Computing	02	--	15	35	50	02	--	**02**
		CA 513B MJP	Lab Course based on CA 512B	--	04	15	35	50	--	02	**02**
	RM	CA 531 RM	Research Methodology	04	--	30	70	100	04	--	**04**
			Total	**16**	**12**	**165**	**385**	**550**	**16**	**06**	**22**

SEMESTER II

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.0	MC	CA 551 MJ	Web Technologies	04	--	30	70	100	04	--	**04**
		CA 552 MJ	Introduction to Data Science	04	--	30	70	100	04	--	**04**
		CA 553 MJ	Computer Networks	02	--	15	35	50	02	--	**02**
		CA 554 MJP	Lab course based on CA 551	--	04	15	35	50	--	02	**02**
		CA 555 MJP	Lab course based on CA 552	--	04	15	35	50	--	02	**02**
	ME	CA 560A MJ	Advance Java Programming	02	--	15	35	50	02	--	**02**
		CA 561A MJP	Lab Course on based on CA 560A MJ	--	04	15	35	50	--	02	**02**
		OR									
		CA 562B MJ	C# .NET	02	--	15	35	50	02	--	**02**
		CA 563B MJP	Lab Course on based on CA 562B	--	04	15	35	50	--	02	**02**
	OJT/FP	CA 581 OJT/FP	Industry Internship/Field Project	--	--	30	70	100	--	04	**04**
			Total	**12**	**12**	**165**	**385**	**550**	**12**	**10**	**22**

STRUCTURE FOR M. Sc. (Computer Applications) AS PER NEP GUIDELINES

SEMESTER III

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.5	MC	CA 601 MJ	Artificial Intelligence and Machine Learning	04	--	30	70	100	04	--	**04**
		CA 602 MJ	Web Services	04	--	30	70	100	04	--	**04**
		CA 603 MJ	Software Engineering	02	--	15	35	50	02	--	**02**
		CA 604 MJP	Lab Course based on CA 601 MJ	--	04	15	35	50	--	02	**02**
		CA 605 MJP	Lab Course based on CA 602 MJ	--	04	15	35	50	--	02	**02**
	ME	CA 610A MJ	Mobile Application Development	02	--	15	35	50	02	--	**02**
		CA 611A MJP	Lab Course based on CA 610A MJ	--	04	15	35	50	--	02	**02**
		OR									
		CA 612B MJ	Software Testing	02	--	15	35	50	02	--	**02**
		CA 613B MJP	Lab Course based on CA 612B MJ	--	04	15	35	50	--	02	**02**
	RP	CA 631 RP	Research work	--	--	30	70	100	--	04	**04**
			Total	**12**	**12**	**165**	**385**	**550**	**12**	**10**	**22**

PROPOSED STRUCTURE FOR M. Sc. (Computer Applications) AS PER NEP GUIDELINES

SEMESTER IV

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.5	MC	CA 651 MJP	Industrial Training#	--	--	100	200	300	--	12	**12**
	ME	CA 660A MJ	MIS	02	--	15	35	50	02	--	**02**
			OR								
		CA 661A MJ	E-Commerce and Digital Marketing	02	--	15	35	50	02	--	**02**
		CA 662B MJ	ERP	02	--	15	35	50	02	--	**02**
			OR								
		CA 663B MJ	Cyber Security	02	--	15	35	50	02	--	**02**
	RP	CA 681 RP	Research Work	--	--	30	70	100	--	06	**06**
			Total	**04**	**--**	**160**	**340**	**500**	**04**	**18**	**22**

SEMESTER I

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)
CA 501 MJ: Database Systems and SQL

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

Course Objectives:

- To be familiar with database management system
- To get acquainted with SQL and PL/SQL
- To understand advanced SQL features and procedural SQL
- To know the concept of triggers and assertions

Course Outcomes:

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

- Enumerate database applications
- Design E-R Model for given requirements and convert the same into database tables.
- Apply Normalization techniques for database design
- Formulate database queries using SQL
- Write Embedded and dynamic queries using SQL/PLSQL

Course Contents

Unit I	Introduction of DBMS	10 Hrs

Introduction of DBMS

- DBMS Overview
- Advantages of DBMS
- Users of DBMS
- Applications of DBMS
- Data models - (Hierarchical, Network, ER, Relational),
- File system Vs. DBMS
- Data independence
- Levels of abstraction
- Architecture of DBMS
- DatabaseLanguages(DDL,DML,DCL)

Unit II	Conceptual Design (E-R model)	14 Hrs

- Overview of DB design
- Entity Types, Entity Sets,
- Attributes ,Attribute Types
- Relationship Types, Relationship Sets, Relationship Degree
- ER Diagrams, Naming Conventions(*Attribute, Entity, Relationship*), and Design Issues;
- ER-to-Relational Mapping,
- Schema Diagrams
- Characteristics of Specialization and Generalization
- keys, Constraints (Primary key, Foreign key, Check. Unique key, Not Null, Default etc)

Unit III	Relational Database Management Systems (RDBMS)	08 Hrs

- Introduction to Relational Database, Relational Database Design,DBMS vs RDBMS
- Functional Dependencies (Full functional dependency Partial functional dependency, Transitive functional dependency),Closure of set of Functional Dependency, Closure of set of attributes
- Decomposition,Properties of Relational Decomposition (Attribute Preservation**,** Dependency Preservation, Lossless join, **N**o redundancy Non Additive Join Property.**)**
- Normalization, Need of Normalization, Normal form (1 NF,2NF,3NF,BCNF),
- Case Studies

Unit IV	Introduction to SQL	08 Hrs

- Introduction to SQL
- Data Types in SQL
- DDL commands (create, alter.drop,rename,desc) with examples
- DML command(insert,delete,update,select)
- DCL command(commit,rollback,grant,revoke)
- Basic structure of SQL SELECT query*(Using BETWEEN, IN, OR,Like ,ORDER BY, GROUP BY and HAVING Clause,Distinct)*
- Aggregate functions,
- Set operations

Unit V	Intermediate SQL	10 Hrs

- Nested ,Sub-queries,*(Using* All,ANY*),*
- Joins and their type
- Grouping and summarizing information– A very common error with GROUP BY– The HAVING clause
- Writing queries on more than one table/multiple table -JOIN– Avoiding ambiguously named columns– Outer JOINs(LEFT OUTER JOIN, RIGHT OUTER JOIN, FULL OUTER JOIN)– Using table aliases– SELF JOINS
- Overview of indexes,views,sequences
- Optimizing Queries with Indexes and views

Unit VI	PL/SQL, Embedded and Dynamic SQL	10 Hrs

- PL/PostgreSQL : Features,Advantages,Language structure,statements and Expressions
- Control flow, conditional statements, loops
- Cursors(Cursor attribute,Types-Implicit,explicit ,parameterized cursor,nesting of cursor)
- Stored procedure(creation,procedure call,implementation)
- Functions(creating ,calling function,passing parameters,returning a value)
- Handling errors and exceptions
- Triggers and Assertions

References :

Sr. No	Title of Books	Name of Author/s	Publisher
1	Database System Concepts	Henry F. Korth, Abraham Silberschatz, S.Sudarshan	Tata McGraw-Hill Education 7th edition
2	Postgresql	Regina obe, Leo Hsu	OReilly publications3rdedition
3	Database Systems	Shamkant B. Navathe, RamezElmasri,	Pearson Higher Education
4	Database Management System	Raghu Ramakrishnan and Johannes Gehrke,	McGraw-Hill 3rd edition

Web References :

1. https://opensource.org/
2. https://www.w3school.com/
3. Wikipedia: https://en.wikipedia.org/
4. Github: https://help.github.com/

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 502 MJ: Python Programming and Data Structures

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

Course Objectives:

- To introduce programming concepts using python
- Student should be able to develop Programming logic using python
- To develop basic concepts and terminology of python programming
- To test and execute python programs
- To be familiar with the concept of Data Structure.
- To learn the systematic way of solving problem
- To understand the different methods of organizing large amount of data
- To efficiently implement the different data structures
- To efficiently implement solutions for specific problems

Course Outcomes:

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

- Develop logic for problem solving
- Determine the methods to create and develop Python programs by utilizing the data
- structures like lists, dictionaries, tuples and sets.
- To be familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
- To write python programs and develop a small application project
- Design and implement Data structures and related algorithms
- Understand several ways of solving the same problem.
- To use well-organized data structures in solving various problems.
- To differentiate the usage of various structures in problem solution.
- Implementing algorithms to solve problems using appropriate data structures.

Course Contents

Unit I **Basics of Python Programming** **08 Hrs**

1.1 Introduction to python
1.2 Features of Python,
1.3 Identifiers, Reserved Keywords, Variables, Comments, Indentation in Python, Multiline Statements
1.4 Input, Output and Import Functions
1.5 Operators (Arithmetic, Comparison, Assignment, Bitwise, Logical, Membership, Identity), operator precedence
1.6 Data Types and Flow Control (Numbers, Strings, List, Tuple, Set, Dictionary , Data type conversion , Decision Making (if, for, while, nested loops, control statements, types of loops))
1.7 Python tuples and sets
Operations on tuples – Concept, operations and built-in functions.
Sets - Concept, operations and built-in functions.
1.8 Python Dictionary(Concept (mutable),Creating and accessing values in a dictionary, Updating dictionary, delete dictionary elements, Properties of dictionary keys, built-in dictionary functions and methods

Unit II	**Python Lists and Python Arrays**	**06 Hrs**
	2.1 Python Lists - concept, creating and accessing elements, updating & deleting lists, basic list operations, reverse, Indexing, slicing, built-in List functions, Functional programming tools - filter(), map(), and reduce()	

	,Using Lists as stacks and Queues, List comprehensions 2.2 Python Array - Concept of array- Array Representation, creating python array , accessing array elements. 2.3 Types of Arrays – One , Two and Multidimensional array. 2.4 Array Operations-Traverse, Insertion, deletion, search and update 2.5 array slicing, python list vs array	
Unit III	**Functions and Object oriented concepts**	**06 Hrs**
	3.1 Functions: Definitions and Uses, Function Calls, Parameters and Arguments, Variables and Parameters, Void Functions, Anonymous, Recursion, Lambda function Functional programming tools - filter(), map(), and reduce() 3.2 Python Classes / Objects Object oriented programming and classes in Python - creating classes, instance objects, accessing members ,Data hiding (the double underscore prefix) ,Built-in class attributes ,Recursive calls to methods ,Class variables, class methods, and static methods	
Unit IV	**Introduction to Data Structure, Sorting and Searching**	**04 Hrs**
4.1 Concept , Need of Data Structure , Types of Data Structure 4.2. Algorithm analysis : definition, characteristics , Space complexity, time complexity 4.3 Asymptotic notation (Big O(Oh), Omega Ω) 4.4 Sorting algorithms with efficiency - Bubble sort, Insertion sort, Merge sort, Quick Sort 4.5 Searching techniques –Linear Search, Binary search		
Unit V	**Stacks and Queues**	**12 Hrs**
Stack : 5.1 Introduction 5.2 Representation- Using Arrays 5.3 Operations – init(), push(), pop(), isEmpty(), isFull(). 5.4 Application - infix to postfix, infix to prefix, postfix evaluation, 5.5 Simulating recursion using stack **Queue :** 5.6 Introduction 5.7 Representation - - Using Arrays 5.8 Operations - init(), enqueue(), dequeue(), isEmpty(), isFull() 5.9 Types of Queue - Linear Queue, Circular Queue, Priority Queue, 5.10 Concept of doubly ended queue		
Unit VI	**Linked List**	**09 Hrs**
6.1 Introduction to Linked List 6.2 Implementation of Linked List – Static & Dynamic representation, 6.3 Types of Linked List – Singly, Doubly, Circular 6.4 Operations on Linked List - create, display, insert, delete, reverse, search, sort, concatenate & merge 6.5 Representing stacks and queues using linked lists		
Unit VII	**Trees**	**09 Hrs**
7.1 Concept & Terminologies 7.2 Types - Binary tree, binary search tree , expression tree 7.3 Representation – Static and Dynamic 7.4 Operations on BST – create, Insert, delete, search , traversals (preorder, inorder, postorder), counting leaf, non-leaf & total nodes , non recursive inorder traversal		
Unit VIII	**Graph**	**06 Hrs**

8.1 Concept & terminologies
8.2 Graph Representation – Adjacency matrix, adjacency list, inverse Adjacency list, adjacency multi list,
8.3 Graph Traversals – Breadth First Search and Depth First Search

Reference Books:

1. An Introduction to Computer Science using Python 3 by Jason Montojo, Jennifer Campbell, Paul Gries, The pragmatic bookshelf-2013
2. James Payne, “Beginning Python: Using Python and Python 3.1,Wrox Publication
3. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python “, Green Tea Press, 2002
4. Introduction to Problem Solving with Python by E balguruswamy,TMH publication2016 5. Beginning Programming with Python for Dummies Paperback – 2015 by John Paul Mueller
5.Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O„Reilly Publication
6. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
7. Data Structures – Horowitz, Sahani
8. Problem-Solving in Data Structures & Algorithms Using Python by Robert Karamagi
9. Algorithms & Data Structure in Python by Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser – Wiley Publication, student edition
10. Problem Solving in Data Structure & Algorithms using Python by Hemant Jain – Second Edition

Web references :

1. www.w3schools.com
2. www.tutorialspoint.com
3. www.javatpoint.com
4. www.geeksforgeeks.com
5. www.programiz.com
6. www.theserverside.com
7. www.educba.com
8. www.sanfoundry.com
9. www.prepbytes.com
10. www.codercampus.com

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 503 MJ - Operating Systems

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

Course Objectives:

- To Understand the basic concepts of operating system.
- To study Architecture, File systems and basic operating system commands.
- To understand Processes, Threads and Deadlocks
- To analyze memory management schemes.
- To understand I/O management and File systems.

Course Outcomes:

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

- Explain basic concepts of operating system
- Describe algorithms for process, memory and disk scheduling
- Apply technique for inter-process communication and Multithreading.
- Implement concept of critical-section
- Compare and contrast deadlock avoidance and prevention.
- Use functions for file system management

Course Contents

Unit I	Introduction	04 Hrs

1.1 Introduction to Operating Systems, Different services provided by Operating System to Users. 1.2 Introduce the concept of Process, Process States, Process Control Block, User Interface,
System Calls.
1.3 Introduction to Linux Operating System - Features of Linux, Architecture of the Linux, Introduction to File System and Process Environment.

Unit II	File System	06 Hrs.

2.1 File Concept, File Attribute, File Operations, File Types, File Structure
2.2 Access Methods - Sequential Access Method, Direct Access Method, Other Access Methods
2.3 Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic
graph directory, General graph directory
2.4 File System Structure and Implementation - Partitions and Mounting, Virtual File Systems
2.5 Allocation Methods - Contiguous allocation, Linked allocation, Indexed allocation
2.6 Free Space Management – Bit vector, Linked list, Grouping, Counting, Space maps

Unit III	Process Scheduling and Multithreading	06 Hrs.

3.1 Process Scheduling – Scheduling queues, Schedulers, context switch
3.2 Operations on Process – Process creation with program using fork(), Process termination
3.3 Interprocess Communication – Shared memory system, Message passing systems
3.4 Multithreaded Programming – Overview, Multithreading Models
3.5 Basic Concept – CPU-I/O burst cycle, CPU Scheduler, Pre-emptive Scheduling, Dispatcher
3.6 Scheduling Criteria
3.7 Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round robin scheduling, Multiple queue scheduling, Multilevel feedback queue scheduling

Unit IV	**Deadlock**	**06 Hrs.**

4.1 System Model
4.2 Deadlock Characterization – Necessary Conditions, Resource Allocation Graph
4.3 Deadlock Prevention
4.4 Deadlock Avoidance - Safe state, Resource-Allocation-Graph Algorithm, Banker's Algorithm
4.5 Deadlock Detection
4.6 Recovery from Deadlock – Process Termination, Resource Preemption

Unit V	**Memory Management**	**08 Hrs.**

5.1 Introduction – Requirement of Memory management, Logical and Physical Address Space, Static and dynamic Loading, Static and Dynamic Linking
5.2 Memory Management Techniques- Contiguous memory management schemes, On-Contiguous memory management schemes
5.3 Swapping- Definition, Benefits of swapping
5.4 Memory allocation- Low Memory, High Memory
5.5 Partition Allocation- Best Fit, First Fit, Worst Fit, Next Fit
5.6 Paging- Use of Paging,
5.7 Fragmentation- External & Internal Fragmentation
5.8 Segmentation-Virtual Memory Segmentation, Simple Segmentation
5.9 Dynamic Loading, Dynamic Linking

Reference Books

1. Operating Systems Achyut S. Godbole Tata McGraw Hill 2nd edition.

2. Operating Systems D.M. Dhamdhere Tata McGraw Hill 2nd edition.

3. Understanding Operating System: Flynn & Mctloes 4th edition, thomson.

4. Operating Systems Design & implementation Andrew S. Tanenbam, Albert S. Woodhull Pearson.

5. Operating System Concepts (7th Ed) by silberschatz and Galvin, Wiley, 2000.

6. Operating Systems (5th Ed) – Internals and Design Principles by William Stallings, Prentice Hall, 2000.

7. Operating System Concepts (2nd Ed) by James L. Peterson, Abraham Silberschatz, Addison – Wesley.

8. Computer Organisation and Architecture (4th Ed) by William Stallings, Prentice Hall India, 1996.

9. Modern Operating Systems by Andrew S Tanenbaum, Prentice hall Inida, 1992.

10.UNIX – Sumitabha Das 11.Unix Shell Programming – Yashwant Kanetkar, BPB publications.

E-Resources (E-books, Swayam/NPTEL Videos, Research Papers, URLs for Case studies, online tutorials, tools, blogs, Swayam/NPTEL courses etc):

1) https://onlinecourses.nptel.ac.in/noc21_cs88/preview

2) https://cscie92.dce.harvard.edu/fall2022/slides/Memory%20Management.pdf

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)
CA 504 MJP: Lab course Based on CA 501 MJ & CA 503 MJ

Teaching Scheme: Theory: 04 Hours/Week	**Credits: 02**	**Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks**

Course Objectives:

- To understand basic database management operations.
- To design E-R Model for given requirements and convert the same into database tables.
- To get acquainted with SQL and PL/SQL commands

Course Outcomes:

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

- Create database tables in postgreSQL.
- Write and execute simple, nested queries.

Course Contents

The lab instructor shall frame suitable assignments to cover the following (but not limited to)

Assignment 1: To create simple tables with only the primary key constraint (as a table level constraint & as a field level constraint) (include all data types),

Assignment 2: To create more than one table, with referential integrity constraint, PK constrain, Check constraint, Unique constraint , Not null constraint

Assignment 3: To drop a table, alter schema of a table, insert / update / delete records using tables created in previous Assignments. (use simple forms of insert / update / delete statements)

Assignment 4: To query the tables using simple form of select statement 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 <>]

Assignment 5: To query table, using set operations (union, intersect)

Assignment 6: To Write cursor and trigger, function and stored procedure

Assignment 7: To implement scheduling algorithms like FCFS, RR, SJF

Assignment 8: To implement bankers algorithm

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 505 MJP: Lab course based on CA 502 MJ

Teaching Scheme: **Theory: 04 Hours/Week**	**Credits 02**	**Examination Scheme:** **Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Python Assignment List

ASSIGNMENT NO.1:-BASIC PYTHON

1) Write a Python Program to Calculate the Average of Numbers in a Given List. 2)
2) Write a program which accepts 6 integer values and prints "DUPLICATES" if any of the values entered are duplicates otherwise it prints "ALL UNIQUE". Example: Let 5 integers are (32, 10, 45, 90, 45, 6) then output "DUPLICATES" to be printed.
3) 3) Write a program to display following pattern.

```
1
2  3
4  5  6
7  8  9  10
```

ASSIGNMENT NO 2:- PYTHON TUPLES

1. Reverse the following tuple aTup = (10, 20, 30, 40, 50)
2. Write a Python program to create a list of tuples with the first element as the number and second element as the square of the number.
3. Copy element 44 and 55 from the following tuple into a new tuple tuple1 = (11, 22, 33, 44, 55, 66)
4. Write a Python program to get the 5th element from front and 5th element from last of a tuple.
5. Write a Python program to find the repeated items of a tuple.
6. Write a Python program to check whether an element exists within a tuple.

ASSIGNMENT NO 3:- PYTHON SETS

1. What is the output of following program:

```
sets = {1, 2, 3, 4, 4}
    print(sets)
```

2. Write a Python program to do iteration over sets.
3. Write a Python program to add and remove operation on set.
4. Write a Python program to find maximum and the minimum value in a set.

ASSIGNMENT NO.4:- PYTHON DICTIONARY

1. Write a Python program to combine two dictionary adding values for common keys.
   Sample Dictionary:
   d1={'a':100,'b':200,'c':300}
   d2={'a':300,'b':200,'d':400}
   Sample output: Counter({'a': 400, 'b': 400, 'd': 400, 'c': 300})
2. Write a Python script to generate and print a dictionary that contains a number (Between 1 and n) in the form (x, x*x).
   Sample Dictionary (n = 5)
   Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
3. Write a Python program to create a dictionary from a string.
   Sample-String:'W3resource'

Expected output: {'3': 1, 's': 1, 'r': 2, 'u': 1, 'w': 1, 'c': 1, 'e': 2, 'o': 1}

ASSIGNMENT NO.5:-PYTHON ARRAY

1. Write a python program to create an array of 5 integers and display the array elements. Access individual elements through indexes
2. write a python program to get the number of occurrences of specified elements in an array
3. Write a python program to reverse the order of the items in the array

ASSIGNMENT NO.6:-PYTHON FUNCTIONS

1. Write a python function to sum of all the elements in a list
2. Write a python function to calculate the factorial of a number.the function accept the number as an argument.
3. Write a python function to check whether a number falls within a given range.
4. Write a python function that takes a list and returns a new list with distict elements from the first list

   Sample list:[1, 2 , 2, 3, 3, 3, 3, 4, 5]

   Unique list:[1, 2, 3, 4, 5]

DATA STRUCTURES Assignment List

The lab instructor shall frame suitable assignments

Assignment 1: Searching Algorithms - Implementation of searching algorithms to search an element using: Linear Search, Binary Search

Assignment 2: Sorting Algorithms - Implementation of sorting algorithms: Bubble Sort, Insertion Sort , Quick Sort, Merge Sort

Assignment 3: Singly Linked List -1. Dynamic implementation of Singly Linked List to perform following operations: Create, Insert, Delete, Display, Search, Reverse 2. Create a list in the sorted order.

Assignment 4: Doubly Linked List - Dynamic implementation of Doubly circular Linked List to perform following operations: Create, Insert, Delete, Display, Search

Assignment 5: Linked List Applications - Merge two sorted lists.

Assignment 6: Stack - Static and Dynamic implementation of Stack to perform following operations: Init, Push, Pop, Isempty, Isfull

Assignment 7: Applications of Stack - 1. Implementation of an algorithm that reverses string of characters using stack and checks whether a string is a palindrome. 2. Infix to Postfix conversion. Evaluation of postfix expression.

Assignment 8: Linear Queue - Static and Dynamic implementation of linear Queue to perform following operations: Init, enqueue, dequeue, IsEmpty, IsFull.

Assignment 9: Circular and Priority Queue 1. Implementation of circular queue 2. Implementation of priority queue

Assignment 10: Tree Travarsals, operations etc

Assignment 11 : Calculate indegree and out degree of a given graph

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 510A MJ: Java Programming

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

Course Objectives:

- To learn implementation of object-oriented concepts with Java.
- To understand collection classes and interfaces.
- To know the process of application development using Graphical User Interface (GUI)

Course Outcomes:

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

- Identify classes, objects, class members and relationships for a given problem.
- Design end to end applications using object-oriented constructs.
- Apply collection classes for storing java objects.
- Use Java APIs for program development.
- Handle abnormal termination of a program using exception handling

Course Contents

Unit I	**Introduction of Java**	**03 Hrs**

1.1 A Short History of Java
1.2 Features of Java
1.3 Java Environment – Compiler, Interpreter, JVM
1.4 Structure of java program
1.5 Data types, Variables, Operators, Keywords, Naming Convention
1.6 Decision Making (if, switch), Looping (for, while)
1.7 Type Casting
1.8 Array, Types of Arrays - One Dimensional arrays - Two-Dimensional array
1.9 Accepting input using Command line arguments
1.10 Accepting input from console (Using BufferedReader and Scanner

Unit II	**Classes and Objects**	**04 Hrs**

2.1 Introduction to classes and objects
2.2 Defining Your Own Classes
2.3 Access Specifiers (public, protected, private, default)
2.4 Array of Objects
2.5 Constructor, types of constructor (default and parameterized) , Overloading Constructors and use of ‘this’ Keyword
2.6 static block, static fields and methods
2.7 Predefined class – Object class methods (equals (), toString(), hashcode(), getClass())
2.8 Garbage Collection (finalize() Method)

Unit III	**Inheritance, Interface and Package**	**08 Hrs**

Inheritance
3.1 Inheritance Basics (extends Keyword) and Types of Inheritance
3.2 Superclass, Subclass and use of super Keyword
3.3 Method Overriding and runtime polymorphism
3.4 Use of final keyword related to variable, method and class
3.5 Use of abstract class and abstract methods
Interface
3.6 Defining and Implementing Interfaces
3.7 Runtime polymorphism using interface

Packages
3.8 Creating, Accessing and using Packages

Unit IV	Collection, Exception Handling and I/O	08 Hrs

Collections
4.1 Wrapper Classes
4.2 Introduction to the Collection framework
4.3 List – ArrayList, LinkedList and Vector
4.4 Set - HashSet, TreeSet, and LinkedHashSet
4.5 Map – HashTable ,HashMap, LinkedHashMap, TreeMap
4.6 Interfaces such as Iterators, ListIterators, Enumerations
Exception Handling
4.7 Exception class, Checked and Unchecked exception
4.8 Catching exception and exception handling – try, catch, finally, throw and throws, multiple catch block
4.9 Creating user defined exception
I/O
4.10 String class(basic methods), String Buffer class
4.11 File class
4.12 DataInputStream and DataOutputStream class

Unit V	Swing	07 Hrs

5.1 What is Swing?
5.2 The MVC Architecture and Swing
5.3 Layout Manager and Layouts, The JComponent class
5.4 Components – JLabel, JButton, JText, JTextArea, JCheckBox, JRadioButton, JList, JComboBox, JMenu and JPopupMenu Class, JMenuItem
5.5 Dialogs (Message, confirmation, input), JFileChooser
5.6 Event Handling: Event sources, Listeners – ActionListener, ItemListener
5.7 Mouse and Keyboard Event Handling, Adapters – MouseAdapter, KeyAdapter

Reference Books:

1) Core Java Volume I - Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-0-13-516630-7

2) The Complete Reference By Herbert Shildt, 11th Edition, McGraw Hill Education, ISBN 978-260-44023-2

3) Java Beginners Guide By Herbert Shildt, 8 th Edition, McGraw-Hill Education ISBN 978-1-260-44021-8

4) Core Java Volume II – Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-013-516631-4

5) Java 2 Programming Black Book By Steven Holzner, DreamTech Press, ISBN 978-93- 5119-953-4

E-books:

1) The Complete Reference By Herbert Shildt
https://gfgc.kar.nic.in/sirmv-science/GenericDocHandler/138-a2973dc6-c024-4d81-be6d-5c3344f232ce.pdf
2) Java 2 Programming Black Book By Steven Holzner
https://idoc.pub/documents/java-2-black-book-steven-holzner-vyly2rmq9v4m

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 511 MJP : Lab Course based on CA 510A MJ

Teaching Scheme: **Practical:02 Hours/Week**	**Credit** **02**	**Examination Scheme:** **Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Unit I — Introduction of Java

1. Write a Java program to accept a number from user and generate multiplication table of a number. Accept number using Buffered Reader class.
2. Write a Java Program to Reverse a Number. Accept number using command line argument.
3. Write a Java program to print the sum of elements of the array. Also display array elements in ascending order.
4. Write a Java program to print the factors of a given number. (Use Scanner class).
5. Write a Java program to accept a number from user and print all prime numbers up to that number (Use Buffered Reader class).
6. Write a Java Program to Display Armstrong Numbers Between range. Accept range from user.
7. Write java program to check whether number is Perfect or not.
8. Write Java program to find multiplication of two matrix. Accept matrix from user.

Unit II — Classes and Objects

1. Define a class MyNumber having one private integer data member. Write a default constructor initialize it to 0 and another constructor to initialize it to a value. Write methods isNegative, isPositive, isOdd, iseven. Use command line argument to pass a value to the object and perform the above operations.
2. Write a program to create class Account (accno, accname, balance). Create an array of 'n' Account objects. Define static method “sortAccount” which sorts the array on the basis of balance. Display account details in sorted order.
3. Write a program which define class Product with data member as id, name and price. Store the information of 5 products and display the name of product having minimum price (Use array of object).
4. Write a program which define class Employee with data member as id, name and salary Store the information of 'n' employees and display the name of employee having maximum salary (Use array of object).
5. Define a class student having rollno, name and percentage. Define Default and parameterized constructor. Accept the 5 student details and display it. (Use this keyword).
6. Write a program create class as MyDate with dd,mm,yy as data members. Write parameterized constructor. Display the date in dd-mm-yy format. (Use this keyword).
7. Define a class Student with attributes rollno and name. Define default and parameterized constructor. Keep the count of Objects created. Create objects using parameterized constructor and display the object count after each object is created.

Unit III — Inheritance, Interface and Package

Inheritance

1. Define a “Point” class having members – x,y(coordinates). Define default constructor and parameterized constructors. Define two subclasses “ColorPoint” with member as color and subclass “Point3D” with member as z (coordinate). Write display method to display the details of different types of Points
2. Define a class Employee having members – id, name, salary. Define default constructor. Create a subclass called Manager with private member bonus. Define methods accept and display in both the classes. Create “n” objects of the Manager

class and display the details of the worker having the maximum total salary (salary + bonus).

3. Write a Java program to create a super class Employee (members – name, salary). Derive a sub-class as Developer (member – projectname). Derive a sub-class Programmer (member – proglanguage) from Developer. Create object of Programmer and display the details of it. Implement this multilevel inheritance with appropriate constructor and methods.
4. Write a Java program to create a super class Vehicle having members Company and Price. Derive two different classes LightMotorVehicle (mileage) and HeavyMotorVehicle (capacity_in_tons). Accept the information for "n" vehicles and display the information in appropriate form. While taking data, ask user about the type of vehicle first
5. Define an abstract class Staff with members name and address. Define two sub-classes of this class – FullTimeStaff (members - department, salary, hra - 8% of salary, da – 5% of salary) and PartTimeStaff (members - number-of-hours, rate-per-hour). Define appropriate constructors. Write abstract method as calculateSalary() in Staff class. Implement this method in subclasses. Create n objects which could be of either FullTimeStaff or PartTimeStaff class by asking the user 's choice. Display details of all FullTimeStaff objects and all PartTimeStaff objects along with their salary.
6. Create an abstract class Shape with methods area & volume. Derive a class Cylinder (radius, height). Calculate area and volume.

Interface

1. Define an interface "Operation" which has methods area (), volume (). Define a constant PI having a value 3.142. Create a class circle (member – radius), cylinder (members – radius, height) which implements this interface. Calculate and display the area and volume.
2. Define an Interface Shape with abstract method area (). Write a java program to calculate an area of Circle and Sphere. (Use final keyword).

Packages

1. Create a package named "Series" having three different classes to print series: a. Fibonacci series b. Cube of numbers c. Square of numbers Write a java program to generate "n" terms of the above series. Accept n from user.
2. Create a package "utility". Define a class Capital String under "utility" package which will contain a method to return String with first letter capital. Create a Person class (members – name, city) outside the package. Display the person's name with first letter as capital by making use of Capital String.
3. Write a package game which will have 2 classes Indoor & Outdoor. Use a function display () to generate the list of players for the specific game. Use default & parameterized constructor

Unit IV	Collection, Exception Handling and I/O

Collections

1. Construct a linked List containing names of colours: red, blue, yellow and orange. Then extend the program to do the following: i. Display the contents of the List using an Iterator ii. Display the contents of the List in reverse order using a ListIterator iii. Create another list containing pink and green. Insert the elements of this list between blue and yellow
2. Write a program to accept 'n' integers from the user & store them in an Array List collection. Display the elements of Array List.
3. Accept 'n' integers from the user and store them in a collection. Display them in the sorted order. The collection should not accept duplicate elements. (Use a suitable collection). Search for a particular element using predefined search method in the Collection framework.

4. Create a Hash table containing Employee name and Salary. Display the details of the hash table.
5. Create a java application to store city names and their STD codes using an appropriate collection. i. Add a new city and its code (No duplicates) ii. Remove a city from the collection iii. Search for a cityname and display the code

Exception Handling

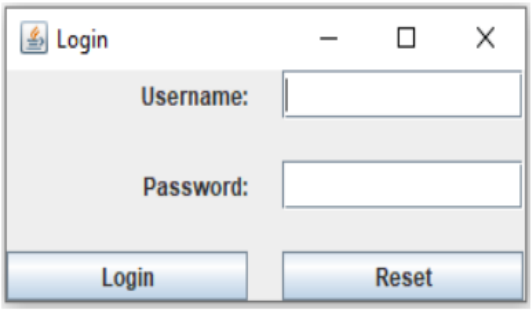
1. **W**rite a java program to accept a number from the user, if number is zero then throw user defined exception —Number is 0, otherwise check whether no is prime or not.
2. Write a java program to accept Doctor Name from the user and check whether it is valid or not. (It should not contain digits and special symbol) If it is not valid then throw user defined Exception - Name is Invalid -- otherwise display it
3. Define a class MyDate (day, month, year) with methods to accept and display a MyDate object. Accept date as dd, mm, yyyy. Throw user defined exception "InvalidDateException" if the date is invalid. Examples of invalid dates : 12 15 2015, 31 6 1990, 29 2 2001.
4. Write a class Driver with attributeslicense_no, name, address and age. Initialize values through the parameterized constructor. If age of Driver is less than 18 then user-defined exception should be generated —Age is below 18 years –
5. Write a class Student with attributes roll no, name, age and course. Initialize values through parameterized constructor. If age of student is not in between 15 and 21 then generate user-defined exception —Age Not Within The Range. If name contains numbers or special symbols raise exception —Name not valid

I/O

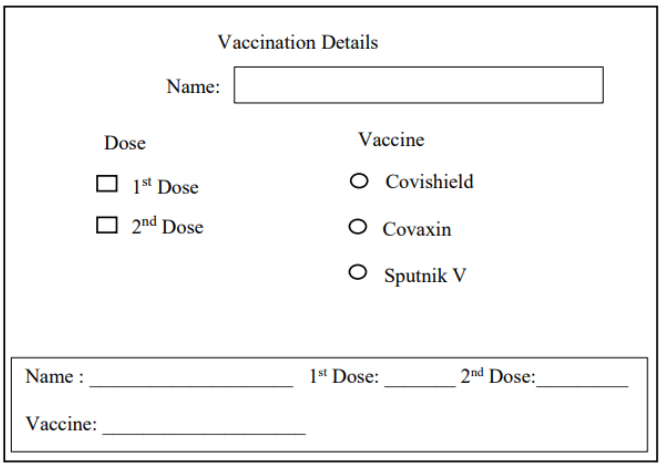
1. Write a java program that displays the number of characters, lines and words of a file.
2. Write a java program to accept details of n customers (c_id, cname, address, mobile_no) from user and store it in a file (Use DataOutputStream class). Display the details of customers by reading it from file. (Use DataInputStream class).
3. Write a program to read the contents of "abc.txt" file. Display the contents of file in uppercase as output.

Unit V	Swing	

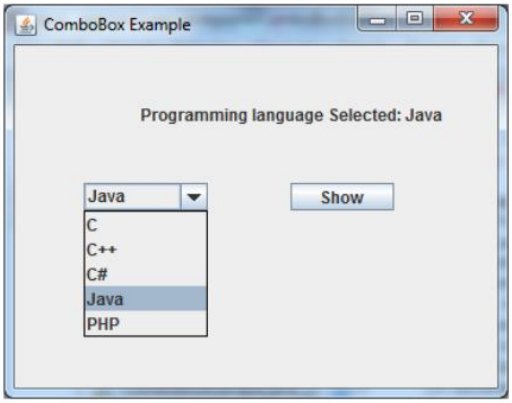
1. Write a java program to design a following GUI. Use appropriate Layout and Components.



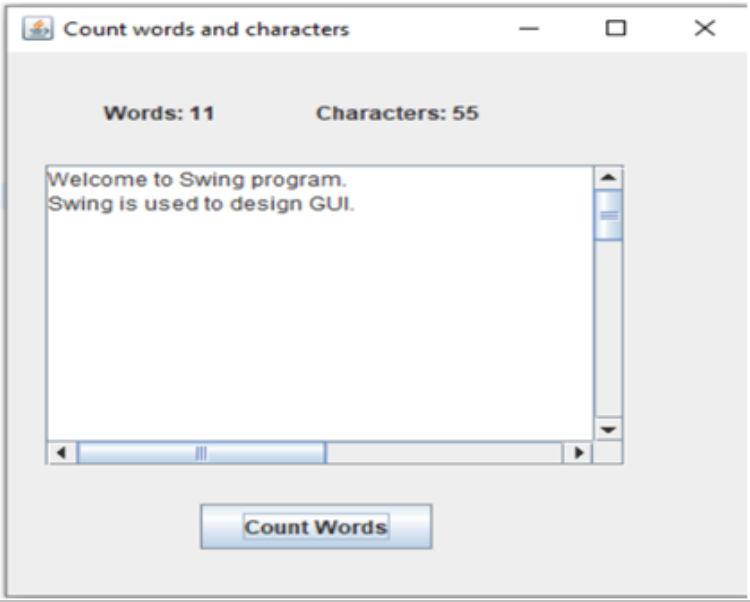
2. Write a java program to design a following GUI. Use appropriate Layout and Components.



3. Write a java program to implement a simple arithmetic calculator. Perform appropriate validations
4. Write a Program to design following GUI by using swing component JComboBox. On click of show button display the selected language on JLabel.



5. Write a program to design following GUI using JTextArea. Write a code to display number of words and characters of text in JLabel. Use JScrollPane to get scrollbars for JTextArea.



Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 512B MJ: Cloud Computing

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

Course Objectives:

- To understand the principles and paradigm of Cloud Computing
- To appreciate the role of Virtualization Technologies
- Ability to design and deploy Cloud Infrastructure
- Understand Advanced Techniques and cloud security issues and solutions

Course Outcomes:

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

- Understand the different Cloud Computing environment
- Analyze virtualization technology and install virtualization software
- Develop and deploy applications on Cloud
- Use advance techniques and apply security in Cloud Computing

Course Contents

Unit I	**Introduction to Cloud Computing**	**08 Hrs**

Overview, Layers and Types of Cloud, Desired Features of a Cloud, Benefits and Disadvantages of Cloud Computing, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Multitenant Technology.
Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology. Cloud Deployment Models.

Unit II	**Virtualization**	**06 Hrs**

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Provisioning in the Cloud Context

Unit III	**Programming, Environments and Applications**	**08 Hrs**

Features of Cloud and Grid Platforms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments, Applications: Moving application to cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services, Cloud Applications.

Unit IV	**Advanced Techniques and Security in The Cloud**	**08 Hrs**

Future Trends in cloud Computing, Mobile Cloud, Comet Cloud. Containers, Docker, and Kubernetes, Introduction to DevOps.
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security - Identity Management and Access Control, Disaster Recovery in Clouds.

Books:

1. Brian J.S. Chee and Curtis Franklin, “Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center”, CRC Press, ISBN:9781439806128

2 . Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, ISBN-13:978-1-25-902995-0

3. Dr. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more”, Wiley Publications, ISBN: 978-0-470-97389-9

E-Resources (E-books, Swayam/NPTEL Videos, Research Papers, URLs for Case studies, online tutorials, tools, blogs, Swayam/NPTEL courses etc):

1. https://sjceodisha.in/wp-content/uploads/2019/09/CLOUD-COMPUTING-Principles-and- Paradigms.pdf
2. https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf
3. Cloud Computinghttps://onlinecourses.nptel.ac.in/noc21_cs14/preview?

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 513B MJP : Lab course based on CA 512B MJ

Teaching Scheme: **Theory: 04 Hours/Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation: 15 Marks** **End-Semester :35 Marks**

Course Objectives:

- To understand the principles and paradigm of Cloud Computing
- To appreciate the role of Virtualization Technologies
- Ability to design and deploy Cloud Infrastructure
- Understand Advanced Techniques and cloud security issues and solutions

Course Outcomes:

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

- Understand the different Cloud Computing environment
- Analyze virtualization technology and install virtualization software
- Develop and deploy applications on Cloud
- Use advance techniques and apply security in Cloud Computing

Course Contents

Assignments

1. Working and Implementation of Infrastructure as a service.
2. Working and Implementation of Software as a service.
3. Working and Implementation of Platform as a services.
4. Practical Implementation of Storage as a Service
5. Installation and Configuration of Virtualization Using KVM
6. Working of Google drive to make spreadsheet and notes.
7. Write a program for web feed.
8. Implementation of Virtualization in cloud computing to learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System.
9. Execute the step to Demonstrate and implementation of cloud on single sign on.
10. Installation and configuration of cloud Hadoop and demonstrate simple query
11. Installing and Developing Application Using Google App Engine
12. Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform
13. Design an Assignment based on working with Manjrasoft Aneka Software.
14. Design and Develop Custom Application (Mini Project) using Salesforce Cloud.

Savitribai Phule Pune University
Second Year of Master of Computer Applications (2023 Course)

CA 531 RM: Research Methodology

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

Course Objectives:

- To investigate some existing situation or problems, explore and analyze it.
- To test hypothesis or theory.
- To identify patterns or trends related to the problem.
- To discover the truth and fact.
- To study the process of quantitative and qualitative data collection.

Course Outcomes:

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

- Understand and comprehend the basics in research methodology.
- Formulate research aims and objectives
- Organize and conduct research (advanced project) in a more appropriate manner.
- Develop and practice the skills necessary to conduct, review, and publish research.
- Write a research report and thesis.

Course Contents

Unit I	**Introduction to Research**	**03 Hrs**

- Definition of Research
- Characteristics of Research
- Objectives of Research
- Nature of Research
- Importance of Research
- Relevance of Research
- Restrictions in Research
- Research Process
- Difference between Research Method and Research Process

Unit II	**Scientific Method**	**8 Hrs**

- Introduction
- Method to Eliminate Uncertainty
- Scientific Method
- Steps in Scientific Method
- Distinction between Scientific Method & Non-Scientific Method
- Difficulties encountered in Scientific Method Research
- Inductive v/s Deductive Logic

Unit II	**Types and Methods of Research**	**10 Hrs**

- Introduction
- Pure and Applied Research
- Exploratory or Formulative Research
- Descriptive Research
- Diagnostic Research
- Evaluation Studies

- Action Research
- Experimental Research
- Analytical Study or Statistical Method
- Historical Research
- Surveys
- Case Study
- Field Studies
- Research ethics
- Plagiarism Tools

Unit IV	Literature Survey and Formulation of Research Problem	10 Hrs

- Purpose of Literature Review
- Literature Resources
- Internet and literature review
- The Research Problem
- The Importance of Formulating a Research Problem
- Steps in Formulation of Research Problem
- Formulation of Objectives
- Establishing Operational Definitions

Unit V	Hypothesis and Sampling	10 Hrs

- What is Hypothesis?
- Nature & Characteristics of Hypothesis
- Significance of Hypothesis
- Types of Hypothesis
- Sources of Hypothesis
- Characteristics of Good Hypothesis
- What is Sampling?
- Aims of Sampling
- Characteristics of Good Sample
- Basis of Sampling
- Advantages of Sampling
- Limitations of Sampling
- Sampling Techniques or Methods
- Probability Sampling Methods
- Non-Probability Sampling Methods
- Sample Design and Choice of Sampling Technique

Unit VI	Data Collection Techniques	06 Hrs

- Introduction
- Distinction between Primary Data and Secondary Data
- Data Collection Procedure for Primary Data
    - Methods of Data Collection –Observation, Questionnaire, Interview, Focus group discussion
-

Unit VII	Quantitative and Qualitative Data Analysis	10 Hrs

- What is Quantitative Data?
- Types of Quantitative Data
- Data Coding
    - Visual Aids for Quantitative Data Analysis-Tables, Bar Charts, Scatter graph, Line Graph etc.
- Use of Statistics for Quantitative Data Analysis
    - Measures of Central Tendency-Mean, Median, Mode
    - Measures of Distribution-Range, Fractiles, Standard Deviation
    - Finding Relationships in the data-Chi-Square, t-test, ANNOVA(f-test),Z-test
- What is Qualitative Data Analysis?
- Analyzing textual and non-textual qualitative data
- Grounded Theory
- Computer-aided qualitative Analysis
- Quantitative and Qualitative Data Analysis Tools

Unit VIII	Presentation of the Research	03 Hrs

- Writing up the research
- Paper presentation in Conference/Journal/Symposium etc
- Poster presentation in exhibition
- Software demonstration
- Case Study -Preparation of Sample Research Paper

Books :

1. Researching Information Systems and Computing by Briony J Oates, SAGE SOUTH ASIA EDITION
2. The Research Methods Knowledge Base, by William M. K. Trochim, James P. Donnelly
3. Introducing Research Methodology: A Beginner's Guide to Doing a Research Project , by Uwe Flick

SEMESTER II

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 551 MJ: Web Technologies

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

Course Objectives:

To understand and learn HTML and CSS
To learn PHP programming and database connectivity
To understand and learn AJAX and XML

Course Outcomes:

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

- Develop web based application using suitable client side and server side web technologies.
- Build Dynamic web site using server side PHP Programming and Database connectivity.
- Build applications using AJAX and XML

Course Contents

Unit I	**Introduction to Web Technology, HTML and CSS**	**06Hrs**

1.1 Introduction to Web Technologies (Define terms : web page, web site, Web Browser, Web Server, URL, www)
1.2. How the Website Works?
1.3. Software to create your website (Traditional method and best website builder)
1.4. What makes good website?
1.5. Client-Server and its Communication
1.6. Internet-Basic, Internet Protocols (HTTP,FTP,IP)
1.7. Types of Websites: Static and Dynamic Websites
1.8Introduction to HTML (different tags, Inserting Image , List, Tables , Text and Image links, Frames, Forms and controls: (text box, buttons controls like submit, reset, radio, checkbox and List box).
1.9 Introduction to CSS, CSS types, CSS Border, margin, Positioning, color, text, link, list, table, padding, image, display properties.
1.10 Use of , , Id & classes in CSS .

Unit II	**Introduction to PHP**	**08 Hrs**

2.1. Introduction to PHP
2.2. PHP - Lexical structure, Language basics.
2.3. Echo, Print Statement
2.4. Variables, Data Types
2.5. Operators
2.6. Control Structures
2.7. Strings

Unit III	**Function and Array in PHP**	**08 Hrs**

3.1. Defining and calling a function
3.2 Default parameters
3.3 Variable parameters, Missing parameters
3.4 Variable function, Anonymous function

3.5 Indexed Vs Associative arrays
3.6 Identifying elements of an array
3.7 Storing data in arrays
3.8 Multidimensional arrays
3.9 Extracting multiple values
3.10 Traversing arrays
3.11 Sorting Using arrays

Unit IV	Object Oriented Programming	6 Hrs

4.1 Classes
4.2 Objects
4.3 Introspection
4.4 Serialization
4.5 Inheritance
4.6 Interfaces
4.7 Encapsulation

Unit V	Web Techniques	08 Hrs

5.1 Variables
5.2 Server information
5.3 Processing forms
5.4 Setting response headers
5.5 Maintaining state
5.6 SSL

Unit VI	Databases	10 Hrs

6.1 Using PHP to access a database
6.2 Relational databases and SQL
6.3 PEAR DB basics
6.4 Advanced database techniques
6.4 Sample application (Mini project)

Unit VII	JavaScript	06 Hrs

7.1 Concept of script, Types of Scripts : client side scripting language and server side scripting language, Introduction to javascript
7.2 Data types, Variables, comments in JavaScript , operators, control structures.
7.3 Functions
7.4 Event Handling in Java Scripts (Event types, dialogue boxes)
7.5 Concept of array, how to use it in JavaScript ,JavaScript array method, types of an Array
7.6 Concept of String
7.7 DOM concept in JavaScript - Methods of document object, How to access field value by document object.

Unit VIII	XML and Ajax	08 Hrs

8.1 What is XML?
8.2 XML document Structure
8.3 PHP and XML
8.4 XML parser
8.5 The document object model
8.6 The simple XML extension
8.7 Changing a value with simple XML
8.8 Understanding java scripts for AJAX
8.9 AJAX web application model
8.10 AJAX –PHP framework
8.11 Performing AJAX validation

8.12 Handling XML data using PHP and AJAX
8.13 Connecting database using PHP and AJAX

Books:

1. Steven Holzner, ”HTML Black Book”, Dremtech press.

2. Web Technologies, Black Book, Dreamtech Press

3. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India

4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson

5. Programming PHP By Rasmus Lerdorf and Kevin Tatroe, O'Reilly publication

6. Beginning PHP 5 , Wrox publication 7. PHP web sevices, Wrox publication

8. AJAX Black Book, Kogent solution 9. Mastering PHP , BPB Publication

10. PHP cookbook, O'Reilly publication

11. PHP for Beginners, SPD publication 8. Programming the World Wide Web , Robert W Sebesta(3rd Edition)

E-Resources (E-books, Swayam/NPTEL Videos, Research Papers, URLs for Case studies, online tutorials, tools, blogs, Swayam/NPTEL courses etc):

1. https://www.w3schools.com

2. https://wwwtutorialspoint.com

3. https://www.php.net

4. Thinking in HTML eBook by Aravind Shenoy

5.The Complete Reference – Steven Holzner
https://books.google.co.in/books?id=bGS4CmJY0I8C&printsec=frontcover&dq=PHP+ebook&hl=en &sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIVTAF#v=onepage&q&f=false

6. Programming PHP – Rasmus Lerdorf, Kevin Tatroe and Peter Macintyre
https://books.google.co.in/books?id=h-E1lVkoskC&printsec=frontcover&dq=PHP+ebook&hl=en&sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHX adDbYQ6AEIcDAI#v=onepage&q=PHP%20ebook&f=false

7. PHP MySQL, JavaScript & HTML5 – A iley Brand
https://books.google.co.in/books?id=p9BuBgAAQBAJ&printsec=frontcover&dq=PHP+ebook&hl=en &sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIQTAD#v=onepage&q&f=false

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)
CA 552 MJ: Introduction to Data Science

Teaching Scheme: Theory: 04 Hours/Week	**Credits 4**	**Examination Scheme: Continuous Evaluation: 30 Marks End-Semester : 70 Marks**

Course Objectives

- Provide students with knowledge and skills for data-intensive problem solving andscientific discovery
- Be prepared with a varied range of expertise in different aspects of data science such asdata collection, visualization, processing and modeling of large data sets.
- Acquire good understanding of both the theory and application of applied statistics andcomputer science based existing data science models to analyze huge data sets originating from diversified application areas.
- Be better trained professionals to cater the growing demand for data scientists inindustry.

Course Outcomes

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

- Perform Exploratory Data Analysis
- Obtain, clean/process, and transform data.
- Detect and diagnose common data issues, such as missing values, special values,outliers, inconsistencies, and localization.
- Demonstrate proficiency with statistical analysis of data.
- Present results using data visualization techniques.
- Prepare data for use with a variety of statistical methods and models and recognize howthe quality of the data and the means of data collection may affect conclusions.

Course Contents

Unit 1	**Introduction to Data Science**	**12 lectures**

Introduction to data science, The 3 V's: Volume, Velocity, Variety,
Why learn Data Science?
Applications of Data
ScienceThe Data Science
Lifecycle Data Scientist's
Toolbox Types of Data
Structured, semi-structured, Unstructured Data, Problems with unstructureddata
Data sources Open Data, Social Media Data, Multimodal Data,
standard datasets:
Data Formats
Integers, Floats, Text Data, Text Files, Dense Numerical Arrays, Compressed orArchived Data, CSV Files, JSON Files, XML Files, HTML Files , Tar Files, GZip Files, Zip Files, Image Files: Rasterized, Vectorized, and/or Compressed

Unit 2	Statistical Data Analysis	16 lectures

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, InterquartileRange
Inferential statistics
Hypothesis testing, Multiple hypothesis testing, Parameter Estimation methods,
Measuring Data Similarity and Dissimilarity
Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes, Dissimilarity of NumericData: Euclidean, Manhattan, and Minkowski distances, Proximity Measures forOrdinal Attributes
Concept of Outlier, types of outliers, outlier detection methods

Unit 3	Data Preprocessing	16 lectures

Data Objects and Attribute Types: What Is an Attribute?, Nominal , Binary, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes
Data Quality: Why Preprocess the Data?Data munging/wrangling operations
Cleaning Data - Missing Values, Noisy Data (Duplicate Entries, Multiple Entries for a Single Entity, Missing Entries, NULLs, Huge Outliers, Out-of- Date Data, Artificial Entries, Irregular Spacings, Formatting Issues - Irregular between Different Tables/Columns, Extra Whitespace, Irregular Capitalization,Inconsistent Delimiters, Irregular NULL Format, Invalid Characters, Incompatible Datetimes)
Data Transformation – Rescaling, Normalizing, Binarizing, Standardizing,Label and OneHot Encoding
Data reduction Data discretization

Unit 4	Data Visualization	16 lectures

Introduction to Exploratory Data AnalysisData visualization and visual encoding Data visualization libraries
Basic data visualization tools
Histograms, Bar charts/graphs, Scatter plots, Line charts, Area plots, Pie charts,Donut charts
Specialized data visualization tools
Boxplots, Bubble plots, Heat map, Dendrogram, Venn diagram, Treemap, 3Dscatter plots
Advanced data visualization tools-
WordcloudsVisualization of geospatial data
Data Visualization types

Reference Books:

1) Data Science Fundamentals and Practical Approaches, Gypsy Nandi, Rupam Sharma, BPB Publications, 2020.
2) The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017
3) Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline

Kamber, Jian Pei, Morgan Kaufmann, 2012.

4) A Hands-On Introduction to Data Science, Chirag Shah, University of Washington Cambridge University Press

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)
CA 553 MJ: Computer Networks

Teaching Scheme: TH: 02 Hours/Week	**Credits** 02	**Examination Scheme:** Continuous Evaluation: 15 Marks End-Semester : 35 Marks

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies.
- To study different techniques for framing, error control, flow control and routing.
- To learn role of protocols at various layers in the protocol stacks.
- To develop an understanding of modern network architectures from a design and performance perspective

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

- Analyze the requirements for a given organization and select appropriate network architecture, topologies, transmission mediums and technologies.
- Analyze data flow between TCP/IP model using Application, Transport and Network Layer Protocols.
- Illustrate applications of Computer Network.
- Compare and contrast different routing and switching algorithms

Course Contents

Unit I	**Introduction to Data Communications Computer Networks**	**06 Hrs**

Data communications, Characteristics of Data Communication
Components of Data communication
Data Representation – Text, Numbers, Images, Audio, Video
Types of Data flow – Simplex, Half Duplex, Full Duplex
Computer Networks applications –Business Application, Home Application, Mobile User
Broadcast and point-to-point networks
Network Topologies - Bus, Star, Ring, Mesh
Network Types- LAN, MAN, WAN, PAN, Wireless Networks, Home Networks, internetworks
Protocols and standards – Definition of a Protocol, Protocol standards: De facto and De jure
OSI Model – layered architecture, peer-to-peer processes, encapsulation
TCP/IP Model – layers and Protocol Suite
Addressing-Physical, Logical, Port addresses, Specific addresses

Unit II	**Physical Layer**	**06 Hrs**

Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length
Baseband Transmission, Broadband Transmission
Transmission Impairments– Attenuation, Distortion and Noise
Data Rate Limits– Noiseless channel: Nyquist's bit rate, noisy channel : Shannon'slaw
Performance of the Network Bandwidth, Throughput, Latency (Delay), Bandwidth – Delay Product, Jitters
Line Coding Characteristics, Line Coding Schemes–Unipolar -NRZ, Polar-NRZ-I, NRZ-L, RZ, Manchester and Differential Manchester, Problems
Transmission Modes, Parallel Transmission and Serial Transmission– Asynchronous and Synchronous and Isochronous
Multiplexing FDM and TDM
Switching-Circuit Switching, Message Switching and Packet Switching.

Unit III	**Data Link Layer**	**05 Hrs**

Framing – Concept, Methods – Character Count, Flag bytes with Byte Stuffing,Starting & ending Flags with Bit Stuffing
Error detection code – Hamming Distance, CRC
Elementary data link protocols - Simplex stop & wait protocol, Simplex protocol for noisy channel, PPP, HDLC
Sliding Window Protocols – 1-bit sliding window protocols, Pipelining – Go-Back N and Selective Repeat
Random Access Protocols - ALOHA– pure and slotted, CSMA-1- persistent, p-persistent and non-persistent CSMA/CD,CSMA/CA
Controlled Access - Reservation, Polling and Token Passing
Channelization – Definitions – FDMA, TDMA and CDMA

Unit IV	Network Layer	05 Hrs

IPv4 addresses: Address space, Notation, Classful addressing, Classless addressing, NAT,
Sub netting, Super netting
IPv4: Datagram, Fragmentation, checksum, options
IPv6 addresses: Structure, address space
IPv6:packet format, Extension headers

Unit V	Transport and Application Layer	08 Hrs

Process-to-Process Delivery, Multiplexing and De-multiplexing
User Datagram Protocol (UDP) - Datagram Format, Checksum, UDP operations, Use of UDP 6.3. Transmission Control Protocol (TCP) - TCP Services – Process to-Process Communication, Stream Delivery Service, Sending and Receiving Buffers, Segments, Full – Duplex Communication, Connection oriented service, Reliable service
TCP Features – Numbering System, Byte Number, Sequence Number, Acknowledgement Number, Flow Control, Error Control, Congestion Control
TCP Segment Format
TCP Vs UDP
Domain Name System (DNS) - Distribution of Name Space, DNS in the Internet
E-MAIL - Architecture, User Agent, Message Transfer Agent - SMTP, Web Based Mail
WWW – Architecture
HTTP - HTTP Transaction

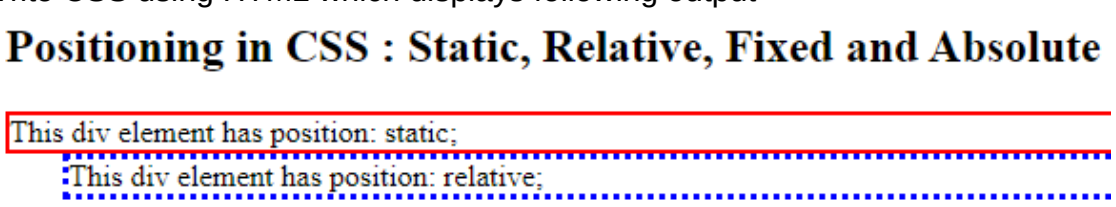
Reference Books:

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

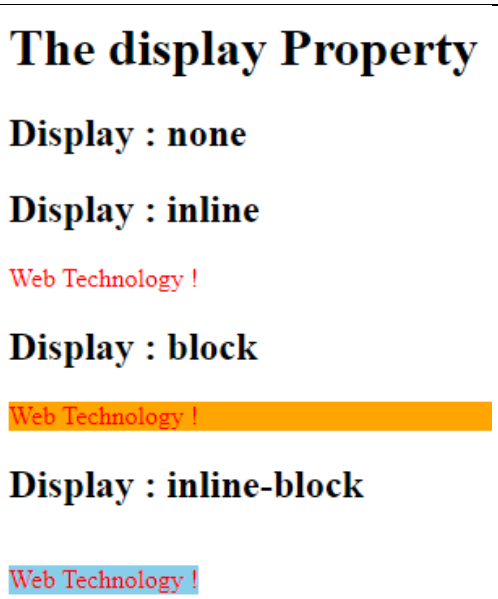
E-Books

1)Computer Networks – Andrew S.Tenenbaum
https://books.google.co.in/books?id=b2HyGSu46lQC&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWlH7cAHR6_BKAQ6AEILjAB#v=onepage&q=Computer%20Networks%20ebook&f=false
2) Computer Networks – Behrouz A. ForouZan and Firouz Mosharraf
https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWlH7cAHR6_BKAQ6AEINzAC#v=onepage&q&f=false
3)Computer Networks – V.S.Bagad and I.A. Dhotre
https://books.google.co.in/books?id=KpOb37EHETcC&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWlH7cAHR6_BKAQ6AEIWjAG#v=onepage&q&f=false

Savitribai Phule Pune University First Year of Master of Computer Applications (2023 Course) CA 554 MJP: Lab Course based on CA 551 MJ		
Teaching Scheme **Practical: 4 hrs / week**	**No. of Credits** **02**	**Examination Scheme** **Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Sr.No.	Practical Assignment : Set I (HTML and CSS)
1	Write HTML programs to display the message “Welcome to Web Technology”
2	Write HTML programs to display word “HTML” in size of h1 to h6
3	Write HTML script to display the text in bold, italic, underline and with strike. Apply separate effect on different text.
4	Write HTML programs to display : H_2O and $A^2 + B^2 = C^2$
5	Write HTML script that will use image as a background.
6	Create an html page with following specifications : a. Title should be about “My City” b. Place your City name at the top of the page in large text and in red color c. Add names and images (as a link) of landmarks in your city each in a different color, style and typeface . d. After clicking on images it should display history of that place.
7	Write HTML code to display following output. ▪ Tea ○ Hot tea ○ Black tea ▪ Coffee • Cold coffee • Hot coffee
8	Write HTML code to display the list of different courses available in our college using ordered as well as unordered list.
9	Design a table which shows weekly time table of a specific class.
10	Divide a screen in four equal part . Each frame shows : list of different activities conducted by your department.
11	Design a admission form. which should contains : text box, multiline text box, a table which shows your academic record, radio button, check box, submit button etc.
12	Write inline CSS program to display with background color pink with red colored text.
13	Write internal CSS program to display with background color black with white colored text.
14	Write external CSS program to display with background color sky blue with blue colored text.
15	Write CSS using HTML which uses of text decoration, border, padding and margin.
16	Write CSS using HTML which displays following output 

	This div element has position: absolute; This div element has position: fixed;
17	Write CSS using HTML which displays following output **List Property in CSS** **Unordered lists** ○ Coffee ○ Tea ○ Milk ▪ Apple ▪ Mango ▪ Banana ▪ Watermelon Ordered list I. Rose II. Jasmine III. Marigold a. Sunflower b. Tulip c. Lily d. Tuberose
18	Write CSS using HTML which displays following output **Add a border to a table:** Firstname | Lastname Ram | Joshi Sham | Kulkarni
19	Write CSS using HTML which displays following output : use image property 
20	Write CSS using HTML which displays following output

	
21	Write CSS using HTML which displays following output : Use of Id and classes in CSS 
22	Write CSS using HTML which displays following output : Use of and in CSS 
Sr.No.	**Practical Assignment : Set II (Introduction to PHP)**
1	Write a PHP script for the following. a) Design a form to accept the details of 5 different items such as Item code, Item Name, unit, sold and Rate. b) Display the bill in tabular format. Use only 4 textboxes. [Use explode]
2	Design a HTML form to accept a string. Write a PHP script for the following. a) Write a function to count the total number of Vowels from the script. b) Show the occurrences of each Vowel from the script
3	Write a PHP script for the following. Design a form to accept a string and check whether the given string is Palindrome or not.
4	Write a PHP Script to accept customer Name from user and do the following a) Transform Customer Name all Upper case latter. b) Make First character to Upper Case.
5	Write a PHP script to print following floyd's triangle. 1 2 3 4 5 6 7 8 9 10

6	Write a PHP script to display source code of a webpage.
7	Write a PHP script to test whether a number is greater than 30, 20 or 10 using ternary operator**.**
8	Write a PHP script to display Multiplication table in tabular format. Design HTML page to accept value.
9	Write a PHP script to display Number in words. Design HTML page to accept number.
10	Write a PHP script to accept details of Employee (Name, Salary, Designation, Address) and display it on next page.
Sr.No.	**Practical Assignment : Set III (Function and Array)**
1	Write a PHP script to accept the number from user and Write a PHP function to calculate the factorial of a number (a non-negative integer). The function accepts the number as an argument.
2	Design a HTML form to accept a string. Write a PHP function that checks whether a passed string is a palindrome or not?
3	Design a HTML form to accept a string. Write a PHP script for the following. a)Write a function to count the total number of Vowels from the script. b) Show the occurrences of each Vowel from the script.
4	Write a PHP script for the following: a) Design a form to accept two numbers from the users. b) Give option to choose an arithmetic operation (use Radio Button). c) Display the result on next form. d) Use concept of default parameter.
5	Write a PHP script for the following: Design a form to accept two strings. Compare the two strings using both methods (= = operator & strcmp function). Append second string to the first string. Accept the position from the user; from where the characters from the first string are reversed. (Use radio buttons)
6	Write a menu driven program to perform the following operations on an associative array: a) Display the elements of an array along with the keys. b) Display the size of an array
7	Write a menu driven program the following operation on an associative array a) Reverse the order of each element's key-value pair. [Hint: array_flip()] b) Traverse the element in an array in random order. [Hint: shuffle()]
8	Declare array. Reverse the order of elements, making the first element last and last element first and similarly rearranging other array elements.[Hint : array_reverse()]
9	Write a menu driven program to perform the following stack related operations. a) Insert an element in stack. b) Delete an element from stack.[Hint: array_push(), array_pop()]
10	Write a menu driven program to perform the following operations on associative arrays: a) Merge the given arrays. b) Find the intersection of two arrays. c) Find the union of two arrays. d) Find set difference of two arrays.
11	Write a menu driven program to perform the following queue related operations a) Insert an element in queue b) Delete an element from queue c) Display the contents of queue
Sr.No.	**Practical Assignment : Set IV(Class and Object)**
1	Write a PHP program to define Interface shape which has two method as area() and volume (). Define a constant PI. Create a class Cylinder implement this interface and calculate area and Volume.

2	a) Write a PHP script to create a Class shape and its subclass triangle, square and display area of the selected shape.(use the concept of Inheritance) Display menu (use radio button) a) Triangle b) Square c) Rectangle d) Circle
3	Write PHP script to demonstrate the concept of introspection for examining object.
4	Create a class named DISTANCE with feet and inches as data members. The class has the following member functions: convert_feet_to_inch() , convert_inch_to_feet() . Display options using radio button and display conversion on next page.
5	Write a PHP program to create a class temperature which contains data members as Celsius and Fahrenheit . Create and Initialize all values of temperature object by using parameterized constructor . Convert Celsius to Fahrenheit and Convert Fahrenheit to Celsius using member functions. Display conversion on next page.
6	Write a Calculator class that can accept two values, then add them, subtract them, multiply them together, or divide them on request.
7	Write a PHP Script to create a super class Vehicle having members Company and price. Derive 2 different classes LightMotorVehicle (members – mileage) and HeavyMotorVehicle (members – capacity-in-tons). Define 5 Object of each subclass and display details in table format .
Sr.No.	**Practical Assignment : Set V (Web Techniques)**
1.	Write a PHP script to display following information using super global variable. a) Client IP Address. b) Browser detection/information. C) To check whether the page is called from ‘https’ or ‘http’.
2	Write a PHP script to keep track of number of times the web page has been access. [Use Session]
3	Write a PHP script to accept username and password. If in the first three chances, username and password entered is correct then display second form with ‘welcome message’ otherwise display error message. [Use Session]
4	Write a PHP script to accept Employee details (eno, ename, address) on first page. On second page accept earning (Basic, Da, HRA). On third page print Employee information(eno,ename, Address, BASIC, DA, HRA, TOTAL) [Hint: Use Session]
5	Write a PHP script to check how many times the web page access.[Use cookies]
6	Write a PHP script to change the preference of your web page like font style, font, size, font color, background color using cookie. Display selected settings on next page and actual implementation (with new settings) on third page.
Sr.No.	**Practical Assignment : Set-VII (Databases (MySQL))**
1.	Consider the following entities and their relationship. Doctor (doc_no, dname, address, city, area) Hospital (hosp_no, hname, hcity)

<table>
<tr><td></td><td>Doctor-Hospital related with many-one relationship.
Create a RDB in 3NF for above and solve the following.
Using above database write a script in PHP to print the Doctor visiting to the hospital in tabular format. Accept hospital name from user[Use MySQL]</td></tr>
<tr><td>2</td><td>Consider the following entities and their relationship.
Student (stud_id, name, class)
Competition(c_no,c_name, type)
a) Relationship between student and competition In many-many with attributes rank and year.
b) Create a RDB in 3NF for above and solve the following.
c) Using above database write a script in PHP to accept a competition from user and display information of student who has secured 1st rank in that competition.</td></tr>
<tr><td>3</td><td>Consider the following entities and their relationship
Emp(e_no, ename, address, phone, salary)
Dept(d_no, dname, location)
Emp-Dept related with many-one relationship.
Create a RDB in 3NF for above and solve the following.

Using above database write a script in PHP which will
a) Insert Employee records and Department records into respective tables.
b) Print a salary statement in the format given below, for a given Department.
[Hint : create a HTML form to accept Department name form user]

<table><tr><td>Maximum Salary</td><td>Minimum Salary</td><td>Sum salary</td></tr><tr><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Sr.No.</td><td>Practical Assignment : Set VI (JavaScript)</td></tr>
<tr><td>1</td><td>Write the JavaScript to convert temperature from Celsius to Fahrenheit.</td></tr>
<tr><td>2</td><td>Write the JavaScript to calculate sum of 5 subjects and find percentage</td></tr>
<tr><td>3</td><td>Write the JavaScript to calculate simple interest.</td></tr>
<tr><td>4</td><td>Write the JavaScript to do swapping of two values. (For example : if A=100 and B=200 , after swapping it becomes A=200 and B=100)</td></tr>
<tr><td>5</td><td>Write the JavaScript to take input as student’s age and check whether given student can be eligible for driving a bike or not</td></tr>
<tr><td>6</td><td>Write the JavaScript to check whether a given year is leap year or not.</td></tr>
<tr><td>7</td><td>Write the JavaScript to WAP to print grade of a student using If Else Ladder Statement</td></tr>
<tr><td>8</td><td>Write the JavaScript to take marks of five subjects. Display total marks and percentage. With the help of percentage print grade of a student using switch case</td></tr>
<tr><td>9</td><td>Write the JavaScript to accept the week day as number from user and display Monday to Sunday.</td></tr>
<tr><td>10</td><td>Write the JavaScript to print table of first n numbers in proper format.</td></tr>
<tr><td>11</td><td>Write the JavaScript to check whether a given number is perfect number or not.</td></tr>
<tr><td>12</td><td>Write the JavaScript to WAP to check whether a given number is prime number</td></tr>
<tr><td>13</td><td>Write the JavaScript to print first n perfect numbers and prime numbers</td></tr>
<tr><td>14</td><td>Write the JavaScript to check whether a given number is armstrong number or not.</td></tr>
<tr><td>Sr.No.</td><td>Practical Assignment : Set-VIII (XML and AJAX)</td></tr>
<tr><td>1.</td><td>Write a script to create XML file as ‘Employee.xml’. The element of this xml file are as follows:
<Empdetails>
<Employee EMPno= Empname=></td></tr>
</table>

	<Salary>--------</Salary> <Designation>-------</Designation> </Employee> </Empdetails>
2.	Write a PHP script to generate an XML in the following format in php. <? Xml version='1.0'encoding=''ISO-8859-1'?> <Book Store> <Books> <PHP> <Title> Programming in PHP </ Title> <Publication>O'RELLY<Publication> </PHP> <PHP> <Title> Beginners PHP</ Title> <Publication> WORX</Publication> </PHP></Books> </Book Store>
3	Write a script to create XML file 'University.xml'. The element details of 'University.xml' Are as follows: <Univ> <Uname>----------</Uname> <CITY>----------</CITY> <Rank>----------<</Rank> </Univ> a) Store the details of at least 3 universities. b) Link the 'University.xml' file to CSS and get well formatted output as given below. i) Uname : Color : black; Font-family: copperplate G0thic Light; Font size: 16pt; Font:Bold; ii) City and Rank Color: Yellow; Font-family: Arial; Font-size : 12pt; Font: Bold;
4	Write a PHP Script to read 'BOOK.xml' file and print specific content of a file using DOMDocument parser. 'Book.xml' file should contain following information with at least 5 records with values. BookInfo Book NO, Book Name, Author Name, Price, Year. [Note: Examiners can change the Book info file to Student info, Teacher info]
5	Write a AJAX program to read contact. Dat file and print the contain of a file in a Tabular form when the user clicks on print button. Contact.dat file contain srno, name, residence number, mobile number, context/ relation. [Enter at least 3 record in contact.dat file] [Note: Examiner may change the contact. dat, dept.dat and provide proper structure of the file]
6	Write AJAX program to print movie by selecting an actor's name. create table Movie and Actor with 1:M cardinality as follows: Movie (mno, mname, release_year)

	Actor(ano, aname) [USE MySQL]
7	Write a AJAX program to search Student name according to the character typed and display list using array
8	Write a AJAX program to print Teacher information from MySQL table Teacher. Teacher (Tno, Name, Subject, Research area). [Note: Examiner can change MySQL table]

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 555 MJP: Lab course Based on CA 552 MJ

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

1) Write a R program to take input from the user (name and age) and display the values. Also print the version of R installation.
2) Write a R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
3) Write a R program to create a simple bar plot of five subjects marks.
4) Write a R program to get the unique elements of a given string and unique numbers of vector.
5) Write a R program to multiply two vectors of integers type and length 3.
6) Write a R program to list containing a vector, a matrix and a list and give names to the elements in the list.
7) Write a R program to create a list containing a vector, a matrix and a list and give names to the elements in the list. Access the first and second element of the list.
8) Write a R program to create a list containing a vector, a matrix and a list and remove the second element.
9) Write a R program to merge two given lists into one list.
10) Write a R program to assign new names "a", "b" and "c" to the elements of a given list.
11) Write a R program to create an empty data frame.
12) Write a R program to create a data frame from four given vectors.
13) Write a R program to create a data frame using two given vectors and display the duplicated elements and unique rows of the said data frame.
14) Write a R program to save the information of a data frame in a file and display the information of the file.
15) Write a R program to create an ordered factor from data consisting of the names of months.
16) Write R program to find whether given number is positive or negative.
17) Write R program to read number and print corresponding day name in a week
18) Create a Matrix using R and Perform the operations addition, subtraction, multiplication.
19) Using R import the data from Excel/.CSV file and find mean, median, mode, quartiles.
20) Using R import the data from Excel/.CSV file and find standard deviation, variance and co-variance.
21) Write a R program to count the number of NA values in a data frame column.
22) Write a R program to call the (built-in) dataset air quality. Remove the variables 'Solar.R' and 'Wind' and display the data frame.
23) Write a R program to compare two data frames to find the row(s) in first

data frame that are not present in second data frame
24) Write a R program to create a factor corresponding to height of women data set, which contains height and weights for a sample of women.
25) Write a R program to find nth highest value in a given vector.
26) Write an R program to sort a Vector in ascending and descending order.
27) Write an R program to extract first 10 English letter in lower case and last 10 letters in upper case and extract letters between 22nd to 24th letters in upper case.
28) Write an R Program to calculate Decimal into binary of a given number.
29) Write an R program to convert a given matrix to a list and print list in ascending order.
30) Write an R program to create a Data frames which contain details of 5employees and display the details in ascending order.
31) Consider the inbuilt iris dataset i) Create a variable “y” and attach to it the output attribute of the “iris”dataset .ii) Create a barplot to breakdown your output attribute. iii) Create a density plot matrix for each attribute by class value.
32) Consider Weather dataset i) Selecting using the column number ii) Selecting using the column nameiii) Make a scatter plot to compare Wind speed and temperature.
33) Write a script in R to create a list of students and perform thefollowingi) Give names to the students in the list. ii) Add a student at the end of the list. iii) Remove the first Student.iv) Update the second last student.

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 560A MJ: Advanced Java Programming

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

Course Objectives:

- To learn database programming using Java
- To study web development concept using Servlet and JSP
- To develop a game application using multithreading
- To learn socket programming concept

Course Outcomes:

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

- To access open database through Java programs using Java Data Base Connectivity (JDBC) and develop the application.
- Understand and create dynamic web pages, using Servlets and JSP.
- Work with basics of framework to develop secure web applications

Course Contents

Unit I	**Database Programming**	**08 Hrs**

1.1 The role of jdbc, The design of jdbc
1.2 Types of drivers
1.3 Steps of jdbc to access database
1.3 Connectivity with database
1.4 Create JDBC Statements – Statement, PreparedStatement, CallableStatement
1.5 Scrollable and updatable result sets - TYPE_FORWARD_ONLY, TYPE_SCROLL_INSENSITIVE, TYPE_SCROLL_SENSITIVE - CONCUR_READ_ONLY, CONCUR_UPDATABLE
1.6 Metadata – DatabaseMetadata, ResultSetMetadata (Database : PostgreSQL)

Unit II	**Networking**	**04 Hrs**

2.1 The java.net package - InetAddress, URL, URLConnection class
2.2 Connection oriented transmission – Stream Socket Class
2.3 SocketServer and Socket class
2.4 Creating a Socket to a remote host on a port (creating TCP client and server)
2.5 Simple Socket Program Example.

Unit III	**Multithreading**	**06 Hrs**

3.1 Introduction to Thread
3.2 Life cycle of thread
3.3 Thread Creation
- By using Thread Class
- By Using Runnable interface

3.4 Priorities and Synchronization
3.5 Running multiple thread
3.6 Inter thread communication

Unit IV	**Servlet**	**06 Hrs**

4.1 Introduction to Servlet and Hierarchy of Servlet
4.2 Life cycle of servlet
4.3 Tomcat configuration (Note: Only for Lab Demonstration)
4.4 Handing get and post request (HTTP)
4.5 Handling a data from HTML to servlet

4.6 Retrieving a data from database to servlet
4.7 Session tracking – User Authorization, URL rewriting, Hidden form fields, Cookies and HTTP Session

Unit V	JSP	04 Hrs

5.1 Simple first JSP program
5.2 Life cycle of JSP
5.3 Implicit Objects
5.4 Scripting elements – Declarations, Expressions, Scriplets, Comments
5.5 JSP Directives – Page Directive, include directive
5.6 Mixing Scriplets and HTML
5.7 Example of forwarding contents from database to servlet, servlet to JSP and displaying it using JSP scriplet tag

Unit VI	Introduction to Frameworks	02 Hrs

6.1 Spring
- 6.1.1 Introduction of Spring framework, Bean
- 6.1.2 Spring Applications
- 6.1.3 Spring – MVC framework

6.2 Introduction to Components of Hibernate
6.3 Introduction to Struts and framework
6.4 Introduction to Maven framework, MOJO, POJO

Reference Books:

1) Core Java Volume I - Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-0-13-516630-7

2) The Complete Reference By Herbert Shildt, 11th Edition, McGraw Hill Education, ISBN 978-260-44023-2

3) Java Beginners Guide By Herbert Shildt, 8 th Edition, McGraw-Hill Education ISBN 978-1- 260-44021-8

4) Core Java Volume II – Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-013-516631-4

5) Java 2 Programming Black Book By Steven Holzner, DreamTech Press, ISBN 978-93-5119-953-4

E-books

1) The Complete Reference By Herbert Shildt
https://gfgc.kar.nic.in/sirmv-science/GenericDocHandler/138-a2973dc6-c024-4d81-be6d-5c3344f232ce.pdf
2) Java 2 Programming Black Book By Steven Holzner
https://idoc.pub/documents/java-2-black-book-steven-holzner-vyly2rmq9v4m,

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 561A MJP: Lab Based on CA 560A MJ

Teaching Scheme: **Practical:02 Hours/Week**	**Credits 02**	**Examination Scheme:** **Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Unit I — Database Programming

1. Write a JDBC program to display all the details of the Person table in proper format on the screen. Create a Person table with fields as PID, name, gender, birth_year in PostgreSQL. Insert values in Person table.
2. Write a program to display information about the ResultSet like number of columns available in the ResultSet and SQL type of the column. Use Person table. (Use ResultSetMetaData).
3. Write a JDBC program to display all the countries located in West Region. Create a table Country in PostgreSQL with fields (Name, continent, Capital,Region). Insert values in the table.
4. Write a JDBC program to insert the records into the table Employee(ID,name,salary) using PreparedStatement interface. Accept details of Employees from user.
5. Write a JDBC program to perform search operation on Person table.
    1. Search all the person born in the year 1986.
    2. Search all the females born between 2000- 2005.
6. Write a JDBC program to update number_of_students of “BCA Science” to 1000.Create a table Course (Code,name, department,number_of_students). Insert values in the table.
7. 3. Write a menu driven program to perform the following operations on District(Name, area,population) table.
    1. Insert
    2. Modify
    3. Delete
    4. Search
    5. View All
    6. Exit

Unit II — Networking

1. Write a client-server program which displays the server machine’s date and time on the client machine.
2. Write a program to find primary IP address of the host name which you passed as a parameter
3. Write a program which sends the name of a text file from the client to server and displays the contents of the file on the client machine. If the file is not found, display an error message.
4. Write a program to accept a list of file names on the client machine and check how many exist on the server. Display appropriate messages on the client side.
5. Write a server program which echoes messages sent by the client. The process continues till the client types “END”.
6. Write a program for a simple GUI based chat application between client and server.The

Unit III — Multithreading

1. Write a multithreading program in java to display all the vowels from a given String.
2. Write a multithreading program using Runnable interface to blink Text on the frame.
3. Write a program that create 2 threads – each displaying a message (Pass the message as a parameter to the constructor). The threads should display the messages continuously till the user presses ctrl-c. Also display the thread information as it is running.
4. Write a java program to calculate the sum and average of an array of 1000 integers (generated randomly) using 10 threads. Each thread calculates the sum of 100 integers. Use these values to calculate average. [Use join method]
5. Define a thread called “PrintText_Thread” for printing text on command prompt for n number of times. Create three threads and run them. Pass the text and n as parameters to the thread constructor. Example:
   i. First thread prints “I am in FY” 10 times
   ii. Second thread prints “I am in SY” 20 times
   iii. Third thread prints “I am in TY” 30 times
6. Write a program to simulate traffic signal using threads
7. Write a program in which thread sleep for 6 sec in the loop in reverse order from 100 to 1 and change the name of thread.
8. Write a program to solve producer consumer problem in which a producer produces a value and consumer consume the value before producer generate the next value. (Hint: use thread synchronization)

Unit IV	**Servlet**	

1. Write a servlet program to display current date and time of server.
2. Design a servlet to display “Welcome IP address of client” to first time visitor. Display Welcome-back IP address of client” if the user is revisiting the page. (Use Cookies)
   (Hint: Use req.getRemoteAddr() to get IP address of client)
3. Design the table User (username, password) using Postgre Database. Design HTML login screen. Accept the user name and password from the user. Write a servlet program to accept the login name and password and validates it from the database you have created. If it is correct then display Welcome.html otherwise display Error.html.
4. Design a servlet that provides information about a HTTP request from a client, such as IP address and browser type. The servlet also provides information about the server on which the servlet is running, such as the operating system type, and the names of currently loaded servlets.
5. Write a servlet which counts how many times a user has visited a web page. If the user is visiting the page for the first time, display a welcome message. If the user is re-visiting the page, display the number of times visited. (Use cookies).
6. Write a program to create a shopping mall. User must be allowed to do purchase from two pages. Each page should have a page total. The third page should display a bill, which consists of a page total of whatever the purchase has been done and print the total. (Use HttpSession)

Unit V	**JSP**	

1. Write a Program to make use of following JSP implicit objects:
   i. out: To display current Date and Time.
   ii. request: To get header information.
   iii. response: To Add Cookie
   iv. config: get the parameters value defined in
   v. application: get the parameter value defined in
   vi. session: Display Current Session ID
   vii. pageContext: To set and get the attributes.
   viii. page: get the name of Generated Servlet

2. Create a JSP page which will accept the file extension and display all files in the current directory having that extension. Each filename should appear as a hyperlink on screen.
3. Create a JSP page to accept a number from a user and display it in words:
   Example: 123 – One Two Three.
4. Write a JSP program to perform Arithmetic operations such as Addition, Subtraction, Multiplication and Division. Design a HTML to accept two numbers in text box and radio buttons to display operations. On submit display result as per the selected operation on next page using JSP.
5. Create a JSP page, which accepts user name in a text box and greets the user according to the time on server side.
   Example: If user name is Admin
   Output:
   If it is morning then display message in red color as,
   Good morning, Admin
   Today's date: dd/mm/yyyy format
   Current time: hh:mm:ss format
   If it is afternoon then display message in green color as,
   Good afternoon, Admin
   Today's date: dd/mm/yyyy format
   Current time: hh:mm:ss format
   If it is evening then display message in blue color as,
   Good evening, Admin
   Today's date: dd/mm/yyyy format
   Current time: hh:mm:ss format
   (Hint: To display date and time use GregorianCalendar and Calendar class)
6. Write a JSP program to display number of times user has visited the page. (Use cookies)

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA 562B MJ: C# and .NET

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

Course Objectives:

- To understand development of windows application
- To learn data access mechanism.
- Create a web application
- Understand MVC Framework

Course Outcomes:

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

- Understand the VB.NET,C# and ASP
- Design and develop window based and web based .NET applications.
- Design and Implement database connectivity using ADO.NET .

Course Contents

Unit I	**Introduction to VB .NET**	**08 Hrs**

1.1 Basics of VB.Net
- 1.1.1 Operators
- 1.1.2 Data Types
- 1.1.3 Control Structures

2.2 Build Windows Applications
- 2.2.1 Controls: Form, TextBox, Button, Label, CheckBox, ListBox, ComboBox, RadioButton, DateTimePicker, MonthCalender, Timer, Progressbar,Scrollbar, PictureBox, ImageBox, ImageList, TreeView, ListView, Toolbar, StatusBar, Datagridview
- 2.2.2 Menus and PopUp Menu
- 2.2.3 Predefined Dialog controls: Color,Save,File,Open, Font
- 2.2.4 DialogBox - InputBox(), MessageBox, MsgBox()

Unit II	**Introduction to C#**	**07 Hrs**

2.1. Language Fundamentals
- 2.1.1 Data type and Control Constructs
- 2.1.2 Value and Reference Types, Boxing
- 2.1.3 Arrays
- 2.1.4 String
- 2.1.5 Functions

2.2. Object Oriented Concepts
- 2.1.1 Defining classes and Objects
- 2.1.2 Access modifiers
- 2.1.3 Constructors
- 2.1.4 Inheritance
- 2.1.5 Interface
- 2.1.6 Abstract Class
- 2.1.7 Method Overloading and Overriding

Unit III	ASP .NET	08 Hrs

3.1 What is ASP.NET?
- 3.2 Architecture of ASP.NET
- 3.3 Forms, WebPages, HTML forms
- 3.4 Request & Response in Non-ASP.NET pages
- 3.5 Using ASP.NET Server Controls
- 3.6 Overview of Control structures
- 3.7 Functions
- 3.8 Introduction to Web forms
  - 3.8.1 Web Controls
  - 3.8.2 Server Controls
  - 3.8.3 Client Controls
  - 3.8.4 Navigation Controls
  - 3.8.5 Validations
  - 3.8.6 Master Page

Unit IV	ADO .NET and MVC	07 Hrs

4.1 Basics of Ado.net
- 4.1.1 Connection Object
- 4.1.2 Command Object
- 4.1.3 Dataset
- 4.1.4 Data Table
- 4.1.5 Data Reader Object
- 4.1.6 Data Adapter Object

4.2 Datagridview & Data Binding: Insert, Update, Delete records
4.3 Navigation Using Data Source
4.4 MVC Framework
4.4.1 Creating MVC Application
4.4.2 MVC File & Folder structure

Savitribai Phule Pune University
First Year of Master of Science (Computer Applications) (2023 Course)
CA 563B MJP: Lab Course based on CA 562B MJ

Teaching Scheme: **Theory: 04 Hours/Week**	**Credits 02**	**Examination Scheme:** **IE: 15 Marks** **UE: 35 Marks**

Sample C#.NET Assignments:

1. Write a program to check whether the number is even or odd, print out anappropriate message to the user.
2. Write a program which will find all such numbers which are divisible by5.
3. Write a program which can compute the factorial of a given numbers.
4. Write a program that prints out all the elements of the list that are less than 10.
5. Write a program to determine whether the number is prime or not.
6. Write a program to check whether a number is palindrome or not. (using recursionand without recursion).
7. Write a C# program that reads a number from the user and calculates its squareroot. Handle the exception if the number is negative.
8. Write a C# program that prompts the user to input two numbers and divides them.Handle an exception when the user enters non-numeric values.
9. Write a C# Sharp program that takes three letters and displays them in reverseorder.
10. Write a C# Sharp program that takes a character as input and checks if it is avowel, a digit, or any other symbol.
11. Write a C# Sharp program to accept a person's height in centimeters andcategorize them according to their height.
12. Write a C# Sharp program to read roll no, name and marks of three subjects andcalculate the total, percentage and division.
13. Write a program in C# Sharp which is a menu-driven program to perform simplecalculations.
14. Write a program in C# Sharp to create a function to input a string and count thenumber of spaces within the string.
15. Write a program in C# Sharp to calculate the sum of elements in an array.
16. Write a program in C# Sharp to create a recursive function to find the factorial of agiven number.
17. How to interact with the user, with the Request.QueryString command.
18. Write a program to interact with the user, with the Request.Form command.
19. Write a program to interact with the user, through radio buttons, with theRequest.Form command.
20. Write a program to create an open connection to a data source using the ADOConnection object. Through this connection, you can access and manipulate adatabase.

Savitribai Phule Pune University
First Year of Master of Computer Applications (2023 Course)

CA581 OJT/FP: Industry Internship / Field Project (FP)

Credits 04	Examination Scheme: Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Course Objectives

- To provide students with an experience in working on projects or working within industry
- To inculcate Problem solving skills and work culture of the industry
- To foster team spirit
- To expose students with documentation used in industry

Course Outcomes

On Completion of this course, student will be able to –

- CO1: Make Use of tools used in industry
- CO2: Solve complex problems
- CO3: Effectively communicate and collaborate with team members and mentors.
- CO4: Demonstrate the ability to prepare documentation needed in the SDLC

Guidelines for Conduction of Industry Internship / Field Project

1. Faculty advisors / mentors shall decide whether a student shall work on industry internship or on a field project as per his/her plan/inclination at the beginning of the semester-II or earlier. The OJT may be carried out in physical or online form at the chosen industry.

2. Field Project should be strictly carried out under the guidance of the assigned faculty advisor / mentor. The assigned Faculty advisor / mentor shall monitor and track the OJT/FP

3. Internship / Field Project of 120 Hrs to be undertaken immediately after the end of SEM II examination and should be completed before the commencement of Semester III. However, Field Project may be undertaken during the semester II itself.

4. At the end of the industry internship / Field Project the student shall submit the report based on work undertaken during internship / Field Project as per prescribed format.

5. Student shall submit progress report on a periodic basis to Faculty advisor/ Mentor. Faculty advisor / mentor shall evaluate the work carried out by the student during internship / Field Project on a continuous basis for 30 marks.

6. The panel of examiners appointed shall evaluate the internship / Field Project based on submitted report and documentation for 70 marks.

Faculty of Science & Technology
Savitribai Phule Pune University, Pune

Syllabus for
SY M. SC. (Computer Applications)
(2023 Pattern)
(With effect from A. Y. 2024-25)

Preamble

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), 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 PG programmes vide its circular No. 122/23.

The Ad-hoc Board of Studies in Computer Applications has prepared a structure for M. Sc. (Computer Applications) with following features

- The structure of the course is designed as per National Education Policy (NEP) 2020 and is in line with University circular 122/23.
- The total credits offered for the two years (level 6.0 and level 6.5) with four semesters are 88 with 22 credits assigned for each of the four semesters.
- The programme has Multiple Entry/exit feature.
- Various types of courses includes - Mandatory Courses (MC), Mandatory Elective (ME), Research Methodology, On-job Training (OJT)/Field Project (FP) and Research Project (RP)

I am thankful to Hon. Vice-Chancellor Prof. Dr. S W. Gosavi, Hon. Dean of FoS&T, Prof. Dr. M G Chaskar for their guidance. I am thankful to all board members Prof. Dr. Rahul Patil, Prof. Dr. Razak Sayyad, Mr. Atul Kahate and Mr. Milnd Tanksale for their valuable inputs as well as the teachers from affiliated colleges for their active participation in preparing the draft syllabus.

Prof. Dr. S S Sane
Chairman,
Ad-hoc Board of Studies in Computer Applications
Faculty of Science and Technology, SPPU

M.Sc. (Computer Applications)

Objectives

The objective of the Program is to produce trained software professionals with hands-on experience on state-of-the art technologies who will be able to handle challenges in IT industry. The objectives of M.Sc. (Computer Applications) program are: -

- To produce knowledgeable and skilled human resources that is employable in IT and ITES.
- To impart knowledge required for planning, designing and building Complex Application SoftwareSystems as well as to provide support for automated systems or applications.

M.Sc. (Computer Applications) Program is of Two Years duration with four semesters. It is a Full- Time post graduate Degree Program. The program is based on credit system comprising of total 88 credit points.

It is believed that the proposed syllabus as part of the credit-based system will bring a qualitative change in the way M.Sc. (Computer Applications) is taught, which will offer a more enriched learning experience. It aims to provide students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer applications, systems and technology on people and society. The students shall develop self and life-long learning skills.

Eligibility

(a) Bachelor Degree in Science/Technology/Engineering OR
(b) Bachelor of Computer Applications (B.C.A.) OR
(c) B.Sc.(Computer Science) OR
(d) Bachelor of Computer Science (B.C.S.) OR
(e) B.Sc.(Information Technology) OR
(f) B.Sc.(Data Science) OR
(g) B.Sc.(Cyber and Digital Science) OR
(h) B.Sc. (Cyber Security) OR
(i) B.Sc. (Cloud Computing) OR
(j) Bachelor of Engineering(BE/B.Tech) in Computer Engg/Computer Science & Engg./ Computer Science and Design/ Information Technology/Electronics and Telecommunication/AI and Data Science/AI and Machine Learning/ equivalent OR
(k) B. Voc. in Software Development/ Information Technology OR
(l) B.Sc. with Computer Science as Principal Subject OR
(m) General B.Sc. with Computer Science as one of the subject at TYBSc level Programme

Programme Outcomes:

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

PO 1: Demonstrate understanding of fundamental and advance concepts in emerging areas

PO 2: Design and develop innovative computer applications.

PO 3: Analyze existing research reported in the literature

PO 4: Propose alternate solutions by undertaking research work.

PO 5: Create efficient, reliable, readable and maintainable code.

PO 6: Demonstrate a deeper understanding of the chosen domain.

PO 7: Select appropriate method to solve the given problem

PO 8: Explain complex technical concepts clearly and effectively, both in written and oral forms.

PO 9: Demonstrate ability to collaborate effectively with team members, understand different perspectives, and contribute productively to become successful professional.

PO 10: Demonstrate ability to work with integrity and a sense of social responsibility.

PO 11: Demonstrate self and life-long learning skills

PO 12: Solve computational problems innovatively

PO 13: Apply knowledge gained and critical thinking to develop real-world applications.

Table of Contents

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STRUCTURE FOR M. Sc. (Computer Applications) 2023 Pattern AS PER NEP GUIDELINES

Abbreviations

TH: Theory
CE: Continuous Evaluation
CA: Computer Applications
ME: Mandatory Elective
OJT/FP: On-job Training / Field Project
PR: Practical
EE: End Semester Examination
MC: Mandatory Core
RM: Research Methodology
RP: Research Project

SEMESTER I

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.0	MC	CA 501 MJ	Database Systems and SQL	04	--	30	70	100	04	--	**04**
		CA 502 MJ	Python Programming and Data Structures	04	--	30	70	100	04	--	**04**
		CA 503 MJ	Operating Systems	02	--	15	35	50	02	--	**02**
		CA 504 MJP	Lab course Based on CA 501 MJ & CA 503 MJ	--	04	15	35	50	--	02	**02**
		CA 505 MJP	Lab course based on CA 502 MJ	--	04	15	35	50	--	02	**02**
	ME	CA 510A MJ	Java Programming	02	--	15	35	50	02	--	**02**
		CA 511 MJP	Lab Course based on CA 510A	--	04	15	35	50	--	02	**02**
		OR									
		CA 512B MJ	Cloud Computing	02	--	15	35	50	02	--	**02**
		CA 513B MJP	Lab Course based on CA 512B	--	04	15	35	50	--	02	**02**
	RM	CA 531 RM	Research Methodology	04	--	30	70	100	04	--	**04**
			Total	**16**	**12**	**165**	**385**	**550**	**16**	**06**	**22**

SEMESTER II

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.0	MC	CA 551 MJ	Web Technologies	04	--	30	70	100	04	--	**04**
		CA 552 MJ	Introduction to Data Science	04	--	30	70	100	04	--	**04**
		CA 553 MJ	Computer Networks	02	--	15	35	50	02	--	**02**
		CA 554 MJP	Lab course based on CA 551	--	04	15	35	50	--	02	**02**
		CA 555 MJP	Lab course based on CA 552	--	04	15	35	50	--	02	**02**
	ME	CA 560A MJ	Advance Java Programming	02	--	15	35	50	02	--	**02**
		CA 561A MJP	Lab Course on based on CA 560A MJ	--	04	15	35	50	--	02	**02**
		OR									
		CA 562B MJ	C# .NET	02	--	15	35	50	02	--	**02**
		CA 563B MJP	Lab Course on based on CA 562B	--	04	15	35	50	--	02	**02**
	OJT/FP	CA 581 OJT/FP	Industry Internship/Field Project	--	--	30	70	100	--	04	**04**
			Total	**12**	**12**	**165**	**385**	**550**	**12**	**10**	**22**

STRUCTURE FOR M. Sc. (Computer Applications) AS PER NEP GUIDELINES

SEMESTER III

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.5	MC	CA 601 MJ	Artificial Intelligence	04	--	30	70	100	04	--	**04**
		CA 602 MJ	Machine Learning	04	--	30	70	100	04	--	**04**
		CA 603 MJ	Software Engineering	02	--	15	35	50	02	--	**02**
		CA 604 MJP	Lab Course based on CA 601 MJ	--	04	15	35	50	--	02	**02**
		CA 605 MJP	Lab Course based on CA 602 MJ	--	04	15	35	50	--	02	**02**
	ME	CA 610A MJ	Mobile Application Development	02	--	15	35	50	02	--	**02**
		CA 611A MJP	Lab Course based on CA 610A MJ	--	04	15	35	50	--	02	**02**
		OR									
		CA 612B MJ	Software Testing	02	--	15	35	50	02	--	**02**
		CA 613B MJP	Lab Course based on CA 612B MJ	--	04	15	35	50	--	02	**02**
	RP	CA 631 RP	Research work - I	--	08	30	70	100	--	04	**04**
			Total	**12**	**20**	**165**	**385**	**550**	**12**	**10**	**22**

PROPOSED STRUCTURE FOR M. Sc. (Computer Applications) AS PER NEP GUIDELINES

SEMESTER IV

Level	Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
				TH	PR	CE	EE	Total	TH	PR	Total
6.5	MC	CA 651 MJP	Industrial Training#	--	--	100	200	300	--	12	**12**
	ME	CA 660A MJ	Management Information System	02	--	15	35	50	02	--	**02**
		OR									
		CA 661A MJ	Digital Marketing	02	--	15	35	50	02	--	**02**
		CA 662B MJ	ERP	02	--	15	35	50	02	--	**02**
		OR									
		CA 663B MJ	Information Security	02	--	15	35	50	02	--	**02**
	RP	CA 681 RP	Research Work - II	--	12	50	100	150	--	06	**06**
			Total	**04**	**12**	**180**	**370**	**550**	**04**	**18**	**22**

SEMESTER III

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 601 MJ: Artificial Intelligence

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 4 Hrs./Week	**04**	**Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research related to emerging technology.
- To introduce ideas and techniques underlying the design of intelligent computer systems

Course Outcomes:

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

- Apply the suitable algorithms to solve AI problems
- Identify and apply suitable Intelligent agents for various AI applications
- Build smart system using different informed search / uninformed search or heuristic approaches
- Represent complex problems with expressive language of representation

	Course Contents	
Unit I	**Introduction to Artificial Intelligence**	**12 Hrs**
	Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents, Benefits and limitation of AI, Ethics in AI, AI Components, AI Architectures	
Unit II	**Searching**	**12 Hrs**
	Uninformed Search Algorithms/Blind Search Techniques - Breadth-first Search, Depth-first Search Informed (Heuristic) search Techniques: Generate-and-test, Simple Hill Climbing, Best First Search, Constraint Satisfaction, Means End Analysis, A* and AO*	
Unit III	**Gaming**	**12 Hrs**
	Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms	
Unit IV	**Knowledge Representation**	**12 Hrs**
	Definition of Knowledge, Types of knowledge (Procedural and Declarative knowledge), Approaches to Knowledge Representation Knowledge representation using Propositional and Predicate logic - Conversion to clause form, Resolution in Propositional logic, Resolution in Predicate logic	
Unit V	**Reasoning**	**12 Hrs**

	Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information	

Reference Books:

1. Artificial Intelligence, Tata McGraw Hill, Elaine Rich and Kevin Knight
2. Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
3. Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
4. Introduction to Artificial Intelligence and Expert System, Dan Patterson, Prentice Hall of India
   Pvt. Ltd., New Delhi, 1997
5. Artificial Intelligence: A Modern Approach, Russel &Norvig, Pearson Education
6. Introduction to Machine Learning , Ethem Alpaydin, PHI

E-Resources:

- https://www.oracle.com/in/chatbots/what-is-a-chatbot/
- https://www.dataversity.net/case-study-predictive-analytics-and-data-science-keep-an-eye-on-the-weather/
- https://www.senseforth.ai/conversational-ai-case-studies/SBI-Cards/

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 602 MJ: Machine Learning

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 4 Hrs./Week	**04**	**Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Course Objectives:

- To understand the need for Machine learning
- To study and understand classification methods
- To understand the need for multi-class classifiers.
- To learn the working of clustering algorithms
- To learn fundamental neural network algorithms.

Course Outcomes:

- After successful completion of this course, learner will be able to:
- Identify the needs and challenges of machine learning for real time applications.
- Select and apply appropriately supervised machine learning algorithms for real time applications.
- Implement variants of multi-class classifier and measure its performance.
- Compare and contrast different clustering algorithms.
- Design a neural network for solving engineering problems.

Course Contents

Unit I	**Introduction To Machine Learning**	**12 Hrs**
	Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches	
Unit II	**Supervised Learning: Regression and Classification**	**12 Hrs**
	Linear regression, logistic regression, Evaluation Metrics: MAE, RMSE, R2 Classification: Naïve-based and Decision tree based classifier, K-nearest neighbor, Support vector machine.	
Unit III	**Supervised Learning: Ensembles and Multi-Class classification**	**12 Hrs**
	Ensemble Learning: Bagging, Boosting, Random Forest, Adaboost. Binary-vs-Multiclass Classification, Variants of Multiclass Classification: One-vs-One and One-vs-All Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation	
Unit IV	**Unsupervised Learning**	**12 Hrs**
	K-Means, K-medoids, Hierarchical, and Density-based Clustering, Outlier analysis: introduction of isolation factor, local outlier factor. Evaluation metrics and score: elbow method, extrinsic and intrinsic methods	
Unit V	**Artificial Neural Networks**	**12 Hrs**

	Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions, Introduction to Recurrent Neural Networks and Convolutional Neural Networks	

Reference Books:

1. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning",Vol. 4. No. 4. New York: springer, 2006.
2. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013
3. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory to algorithms", Cambridge university press, 2014.
4. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
5. Goodfellow I.,Bengio Y. and Courville, " A Deep Learning", MIT Press, 2016
6. Charu Agarwal, "Neural Networks and deep learning", A textbook

E-resources:

- Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/
- Dive into Deep Learning: http://d2l.ai/
- A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf
- Introduction to Machine Learning : https://nptel.ac.in/courses/106105152
- Introduction to Machine Learning (IIT Madras): https://onlinecourses.nptel.ac.in/noc22_cs29/prevew
- Deep learning: https://nptel.ac

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 603 MJ: Software Engineering

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives:

- To learn and understand the principles of Software Engineering
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To study agile software development methodology

Course Outcomes:

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

- Compare and contrast various Software Engineering models
- Decide on appropriate process model for a developing a software project
- Classify software applications and Identify unique features of various domains
- Prepare System Requirement Specification (SRS) for the given problem
- Design and analyze Data Flow diagrams

Course Contents

Unit I	**Introduction to Software Engineering**	**06 Hrs**
	Definition of Software, Characteristics of Software, Software Application Domains, Definition of Software Engineering, Need for software Engineering, Mc Call's Quality factors, The Software Process, Software Engineering Practice	
Unit II	**Software Development Life Cycle (SDLC)**	**06 Hrs**
	Introduction, Activities of SDLC, A Generic Process Model, Prescriptive Process models: Waterfall Model, Incremental Model, Prototyping Model, Spiral Model, 3.5 Concurrent Models, Types	
Unit III	**Requirement Engineering**	**06 Hrs**
	Introduction, Requirement Engineering Tasks, Establishing Groundwork for understanding of Software Requirement, Requirement Gathering, Feasibility study, Fact Finding Techniques	
Unit IV	**Analysis and Design Engineering**	**06 Hrs**
	Decision Tree and Decision Table, Data Flow Diagrams (DFD), Data Dictionary (DD), Elements of DD, Advantages of DD, Input and Output Design, Pseudocode, Introduction to Object-oriented analysis and Design	
Unit V	**Agile Development**	**06 Hrs**
	Agility, Agile Process, Principles, The Politics Of Agile Development, Human Factors, Extreme Programming(XP), Adaptive Software Development (ASD), Scrum, Dynamic System Development Model (DSDM)	

Reference Books:

1. Software Engineering : A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010 (Seventh Edition)

2. Fundamentals of Software Engineering- Rajib Mall, PHI Publication, Fourth Edition

E-Resources:

- Software Engineering and Quality Assurance – Mrs Anuradha A. Puntambekar
- https://books.google.co.in/books?id=r203sZeGhhcC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEINDAB#v=onepage&q&f=false
- Software Engineering – Bharat Bhushan Agarawal and Sumit Prakash Tayal
- https://books.google.co.in/books?id=CDWRq0B9e5kC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEIVzAF#v=onepage&q&f=false
- Software Engineering – Jibitesh Mishtre and Ashok Mohanty
- https://books.google.co.in/books?id=YnGz2ghKF-gC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEIaTAH#v=onepage&q&f=false

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 604 MJP: Artificial Intelligence Laboratory

Teaching Scheme:	**Credits**	**Examination Scheme:**
Laboratory: 4 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To learn and apply various search strategies for AI
- To Formalize and implement constraints in search problems

Course Outcomes

After successful completion of the course, students will be able to

- Apply informed search / uninformed search or heuristic approaches
- Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning
- Design and develop an interactive AI application

Guidelines for Instructor's Manual

The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, 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.
Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. 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 shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.

Suggested Laboratory Assignments

01	Implement depth first search algorithm
02	Implement Breadth first search algorithm
03	Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph
04	Implement A star Algorithm
05	Implement AO star Algorithm
06	Use Greedy Search algorithm to implement selection sort
07	Use Greedy Search algorithm to find single source shortest path
08	Use Greedy Search algorithm to obtain Minimum Spanning Tree
09	Develop an elementary Chabot for any suitable customer interaction application.
10	Develop an Expert system for a Hospital or any suitable application.

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 605 MJP: Machine Learning Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Laboratory: 4 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- Develop in depth understanding for implementation of the regression models.
- Learn supervised and unsupervised machine learning algorithms.
- Study Artificial Neural Networks

Course Outcomes

After successful completion of the course, students will be able to

- Implement and evaluate linear regression and random forest regression models.
- Apply and evaluate classification and clustering techniques.

Guidelines for Instructor's Manual

The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, 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.
Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. 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 shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.

Suggested Laboratory Assignments

Visit websites providing datasets for Machine learning from various domains such as Finance, Healthcare, Science etc and download. For example download datasets named "Australian Credits", "BUPA", "Ionosphere" etc. Study the datasets and prepare a descriptive table giving name of the dataset, URL from where it was downloaded, type of dataset (Synthetic/Real-world), No. of Attributes, no. of records, number of classes (if applicable) etc.
Download any open source software such as WEKA and install. Download in-built datasets and include their description in the table mentioned above. Carry out following assignments

01	Using any open source software such as WEKA and its datasets, perform classification using Naïve Bayes classifier, note accuracy
02	Using any open source software such as WEKA and its datasets, perform classification using C4.5 – the decision tree classifier
03	Using any open source software such as WEKA and its datasets, perform classification using Neural network classifier
04	Perform assignment 1 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 1 above

05	Perform assignment 2 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 2 above
06	Perform assignment 3 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 3 above
07	Perform assignment 1 above using any available instant selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 1 above
08	Perform assignment 2 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 2 above
09	Perform assignment 3 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 3 above
10	Perform assignment 2 above using both attribute and instance selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignments 2, 5 and 8 above
11	Using any open source software such as WEKA and its datasets, perform clustering using 'EM' algorithm
12	Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 610A MJ: Mobile Application Development

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To study the Android mobile application development platform
- To understand the essence of Android programming
- To learn Android mobile application development process

Course Outcomes

After successful completion of the course, students will be able to

- Describe architecture, components and lifecycle development of Android application development cycle
- Design simple Android applications
- Apply advanced Android features

Course Contents

Unit I	**Introduction**	**06 Hrs**
	Introduction to Android - Overview and evolution of Android , Features of Android, Android architecture, Components of an Android Application, Manifest file, Android Activity Service Lifecycle	
Unit II	**User Interface**	**06 Hrs**
	Basic UI Designing (Form widgets, Text Fields, Layouts, [dip, dp, sip, sp] versus px), Intent, All components (Button, Slider, Image view, Toast), Event Handling, Adapters and Widgets, Menus	
Unit III	**Threads and Notifications**	**06 Hrs**
	Threads running on UI thread (runOnUiThread), Worker thread, Handlers & Runnable, Asyn Tasks, Broadcast Receivers, Services and notifications, Toast and Alarms	
Unit IV	**Advanced Android Programming**	**06 Hrs**
	Content Providers – SQLite Programming, JSON Parsing, Accessing Phone Service (Call, SMS, MMS), Location based services	
Unit V	**ReactJs**	**06 Hrs**
	React Introduction, Setup and Create Simple Hello World App, Understanding React Foundation or Structure, React ES6, React JSX, React Components, React Classes, React Props, React Events, React DevTools, Reat Data Flow, React Conditionals, React Lists, React Forms, React Router, React Hooks, Building a Simple To-Do List Application (Setup), Deploying React	

Reference Books:

1. Beginning Android Application Development, Wei-Meng Lee, Wiley
2. React Native in Action, nader dabit, Nickie Buckne, O'reilly Publications

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 611A MJP: Mobile Application Development Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Laboratory: 4 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To study the Android mobile application development platform
- To understand the essence of Android programming
- To learn Android mobile application development process

Course Outcomes

After successful completion of the course, students will be able to

- Design simple Android applications
- Apply advanced Android features

Guidelines for Instructor's Manual

The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, 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.
Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. 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 shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.

Suggested Laboratory Assignments

01	Create an Application for registration of users with required fields. Provide Menu items to add, delete and edit with adequate validations
02	Create sample application with login module. Verify Check username and password. On successful login, pass username to next screen and if login fails, prompt the user
03	Create Tables Project (pno, p_name, ptype, duration) and Employee (id, e_name, qualification, join-date), assume Project – employee has a many to many relationship. Using database perform following operation. 1) Add new record into table. 2) Accept a project name from user and display information of employees working on the project.
04	Create application to send and receive messages using SMS Manager.
05	Create application to send an email.
06	Create application with a login form. Validate the user and send an email.
07	Create application to search a specific location on Google Map
08	Create application to calculate distance between two locations on Google Map
09	Create application using JSON to provide Employee information

10	Create an application to capture and send a sales order for a pharma sales agent. Application should first sync using APIs - a) products with rates from server b) customers details. Login should find sales person id based on mobile number and allow him to input a sales order with multiple products. Order should be saved locally and updated on server if connection is available (or sync later with server).
11	Create and Deploy Application covering assignments 1, 2 and 3 above using ReactJs

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 612B MJ: Software Testing

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods
- To know various software testing issues and solutions in software unit test; integration, regression, and system testing
- To learn how to plan and design test cases and data, conduct tests, manage defects, and generate a test reports

Course Outcomes

- Distinguish between white box and black box testing
- Define Software testing life cycle
- Design test cases

Course Contents

Unit I	**Introduction**	**06 Hrs**
	Introduction, Basics of Software Testing, Testing Principles, Goals, Testing Life Cycle, Phases of Testing, Defects, Defect Life Cycle, Defect Report, Test Plan(IEEE format), verification and validation	
Unit II	**White-box testing**	**06 Hrs**
	Introduction, Need of white box testing, Testing types, Test adequacy criteria, static testing by humans, Structural testing - logic coverage criteria, Basis path testing, Graph metrics, Loop Testing, Data flow testing, Mutation Testing, Design of test cases. Testing of Object oriented systems, Challenges in White box testing	
Unit III	**Black-box Testing**	**06 Hrs**
	Introduction, Need of black box testing, Black box testing Concept, Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing, Positive & negative testing, Boundary value analysis, Equivalence Partitioning class, state based or graph based, cause effect graph based, error guessing, documentation testing & domain testing, design of test cases, Integration testing	
Unit IV	**System and Acceptance testing**	**06 Hrs**
	System testing, Functional system testing, Non-functional system testing Acceptance testing, Performance testing, Regression testing, Ad-hoc testing, Internationalization testing, Usability and Accessibility testing	
Unit V	**Test Management, Automation, metrics and measurements**	**06 Hrs**

	Test Planning, Test Management, Test Process, Test Reporting What is test Automation?, Design and Architecture for Automation, Selecting testing tool What are test metrics and measurements? Types of metrics	

Reference Books:

1. Software testing Principle and Practices By Ramesh Desikan, Pearson Education, ISBN 81-7758-121-X 5.
2. Software Testing Principles and Tools By M.G. Limaye TMG Hill Publication, ISBN 13:978-0-07-013990-9 3.
3. Software Testing Principles and Practices By Naresh Chauhan, Oxford University Press, ISBN 0-19-806184-6 4.
4. Software Testing Concepts and Tools By Nageshwar Rao , Dreamtech ,ISBN 81-7722-712-2

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 613B MJP: Software Testing Laboratory

Teaching Scheme:	**Credits**	**Examination Scheme:**
Laboratory: 4 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To understand white box testing
- To know black box testing
- To be familiar with automation tool

Course Outcomes

After successful completion of the course, students will be able to

- Perform white box testing activities
- Apply black box testing concepts
- Enlist features of a automation tool

Guidelines for Instructor's Manual

The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, 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.
Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. 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 shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.

Suggested Laboratory Assignments

01	To study and identify defects in a given data entry form
02	To improve user experience for a given sign-in page
03	Compute Code Coverage (Statement, Path, Condition and Function coverage) for the given code
04	Compute Cyclomatic complexity for a given flow graph
05	Prepare a requirement traceability matrix for a given system
06	Prepare test execution data for the system specified in assignment 5 above
07	Prepare a set of positive and negative test cases for a given system
08	From the given problem, construct a decision table
09	Identify equivalence classes for a given problem statement

10	Develop a use case scenario for the specified system
11	Download, install and use any open source testing tool

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER III

CA 631 RP: Research Work - I

Teaching Scheme:	Credits	Examination Scheme:
Laboratory: 8 Hrs./Week	**04**	**Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Course Objectives

- To provide hands-on experience to research work

Course Outcomes

After successful completion of the course, students will be able to

- Apply research methodology to carry out research in a chosen problem domain
- Design and develop a novel methodology / framework etc
- Conduct experiments and analyze results

Guidelines for carrying out Research work

Each student shall carry out the research work during semester III under the guidance of the appointed faculty Advisor/Mentor. Students shall work on a research problem and publish a paper / file a copyright / patent based on the work carried out. The student shall prepare and submit a report based on the work carried out consisting of – Face Page, certificate, Acknowledgement, Abstract, Table of Contents, List of Tables, List of Figures, Abbreviations, and separate Chapters dealing with Introduction, Literature Review, Design details of Proposed System, Experimental Results and analysis, and a chapter providing Conclusions and future scope. List of Publications, Copyright/patent, references and appendix shall also be included in the report.

Guidelines for Assessment

The work carried out shall be evaluated on a continuous basis by the assigned faculty advisor / mentor for 30 marks and panel of examiners appointed shall evaluate the work based on the report for 70 marks.

SEMESTER IV

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 651 MJ: Industrial Training

Teaching Scheme:	Credits	Examination Scheme:
Laboratory: 24 Hrs/Week	12	Continuous Evaluation: 100 Marks End-Semester : 200 Marks

Course Objectives

- To provide opportunities for students to get professional experience
- To learn and understand real life/industrial situations
- To get familiar with various tools and technologies used in industries and their applications.
- To nurture professional and societal ethics

Course Outcomes

After successful completion of the course, students will be able to

- To demonstrate professional competence
- To apply knowledge gained through training to complete academic activities in a professional manner
- To choose appropriate technology and tools to solve given problem.
- To demonstrate abilities of a responsible professional and use ethical practices in day to day life.
- To analyze various career opportunities and decide carrier goals

Guidelines for Industry Training

Industry training is an educational and career development opportunities, providing practical experience in a field or discipline. It is far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Industry training is structured and supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose students to the industry environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry. Industry training is intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training.

Duration:

The student is expected to carry out online/offline industry training for minimum of 360 hrs during the winter vacation of 4-6 weeks (with at least 30hrs/week) and during semester IV

Identifying place/work for Industrial training

Student may choose to undergo Industry training at Industry/Govt. Organizations/NGO/MSME/Research Labs/Institutes. Students must get training proposals sanctioned from college authority well in advance. Internship work identification process should be initiated in the 3rd semester in coordination with training and placement cell/ industry institute cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their 3rd semester examinations.

Student can undergo training in the form of the following but not limited to:

- Industry / Government Organization
- Working for consultancy/ research project
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell / startups cells of institute
- In-house product development, intercollegiate, inter department research internship under research group, micro/small/medium enterprises/online internship,
- Research internship under professors from reputed Institutes/Research organizations,
- NGOs
- Participate in open source development.

Diary/Workbook:

Students must maintain daily Diary/ Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documentation. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record duly signed and stamped by the industry/organization where the training was carried out

The student shall prepare and submit a report based on the work carried out consisting of –

- Title/Cover Page
- Training completion certificate
- Details of place of training- Company background-organization and activities/Scope and object of the study / Supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the work carried out
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of references (Library books, magazines and other sources)

Guidelines for Assessment

The work carried out shall be evaluated on a continuous basis by the assigned faculty advisor / mentor for 100 marks and panel of examiners appointed shall evaluate the work based on the report for 200 marks.

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 660A MJ: Management Information System

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To learn fundamentals of Information Systems.
- To know methodology and applications of MIS
- To understand how Information System supports in decision making and knowledge management.
- To be familiar with various technologies of MIS

Course Outcomes

After successful completion of the course, students will be able to

- Define need, objectives and architecture of MIS and its role in business planning
- Enlist activities for development of MIS
- Demonstrate understanding of DSS and Knowledge Management
- Describe applications and various technologies of MIS

Course Contents

Unit I	**Introduction to Information Systems**	**06 Hrs**
	Need and objectives of Information systems. Components and resources of information systems, Types of information systems: Operations support systems and Management support systems. Management Information Systems (MIS): Definition, role and impact of MIS, Functions of the managers: planning, organizing, staffing, coordinating and directing, MIS as a support to the management Management of Business: Concept of Corporate Planning, Essentiality of strategic planning, development of business strategies, types of strategies, MIS for strategic Business Planning	
Unit II	**MIS Development and BPR**	**06 Hrs**
	Development of Long range plans of the MIS, Determining Information Requirements, Development and implementation of MIS, Managing Information Quality, MIS – Development process model Business Process Re-engineering (BPR) – Introduction, Business Process, Process and Value Stream model of the organization, MIS and BPR	
Unit III	**Decision Support Systems and Knowledge Management**	**06 Hrs**
	Decision Support Systems (DSS): Concept and philosophy, Characteristics, Components of DSS, tools, Using Decision Support systems: What-if, sensitivity, Goal-seeking analysis and Optimization analysis, GDSS, DSS application in E-enterprise Knowledge Management systems, Knowledge-based expert system, MIS and	

	benefits of DSS	
Unit IV	**Applications of MIS**	**06 Hrs**
	Applications in Manufacturing Sector: HR Management, Marketing Management, Finance Management, Materials Management and Marketing Management Applications in services: Banking, Insurance, Airline, Hotel, Hospital, Education	
Unit V	**Infotech Infrastructure**	**06 Hrs**
	Technology for MIS – Data, Transaction, Application and Information processing. Database and client-server architecture, MIS and RDBMS Data Warehouse (DW) – Data in DW, Architecture and design of DW, Organization, Management implementation of DW, Business Intelligence, DW and MIS E-Business – Introduction, models, security issues, Electronic payment systems, Web enabled Business Management, MIS in Web environment	

Reference Books:

1. Jawadekar W., "Management Information Systems", 6th Edition, Tata McGraw-Hill Publishing
2. KC Laudon, JP Loudon, “MIS Managing digital firm”, Person Education
3. O'Brien James , "Management Information Systems” , 7th Edition, Tata McGravv-Hill
4. Arpita Gopal, Chandrani Singh, “E-world Emerging trends in Information Technology”, Excel Books

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 661A MJ: Digital Marketing

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To study the need of Digital marketing
- To understand the role of Social media in marketing
- To learn SEO and Digital Analytics

Course Outcomes

After successful completion of the course, students will be able to

- Define the core concepts of digital marketing
- Describe the process of creating and running digital media based campaigns
- Identify and utilize various tools such as social media, SEO and analytics

Course Contents

Unit I	**Introduction to Digital Marketing (DM)**	**06 Hrs**
	Introduction, Traditional Vs DM, Internet Users, DM Landscape, DM Strategy, DM Plan, Ethical and Legal framework of DM Display Advertising: Introduction, concept, Digital Metrics, Types of Ads, Display Plan, Targeting in DM , Geographic and Language Targeting, Ad Server, Ad Exchange	
Unit II	**Search Engine Advertising**	**06 Hrs**
	Why pay for Search Advertising?, Ad placement and Ad Ranks, creating campaign, Google Ad account, Enhancing Campaign, Performance reports, E-Commerce Vs Google Ads Introduction to Mobile Marketing – Models, Toolkits and Features	
Unit III	**Social Media Marketing**	**06 Hrs**
	Introduction, Listen, Goal Setting, Strategy, Implementation, Measurement, Improvement, TikTok, Social Entertainment, Gamification Facebook Marketing – Organic and Paid marketing, Insights, Facebook stories, 3D Posts, Managers – Ad, Pixel, pages and Business Linked-in Marketing – Strategy, Sales lead Generation and Analytics Introduction to DM using Twitter, Instagram and Pinterest	
Unit IV	**Search Engine Optimization (SEO)**	**06 Hrs**
	Concept, Phases, Website Audit, Optimization (On and Off page), the Google Search Engine, SEO – UX and UI	
Unit V	**Digital Analytics**	**06 Hrs**
	Data Collection, Key Metrics, Outcome and Experience Analysis, Creating Executive dashboards, Affiliate Marketing, Introduction attribution models	

	Video Marketing (VM) – VM Using Youtube and Twitter, Types of VM, Video Analytics	

Reference Books:

1. Digital Marketing, Seema Gupta, 2nd Edition, Mc-GrawHill
2. Digital Marketing, Vanadana Ahuja, 2nd Edition, Oxford University Press
3. Digital Marketing for Dummies, Ryan Deiss, Russ Henneberry, Dummies
4. Traffic Secrets, Russell Brunson, Google Books

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 662B MJ: ERP

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To learn Basics of ERP, CRM and SCM
- To study ERP Selection process
- To understand various aspects of ERP Project Management

Course Outcomes

After successful completion of the course, students will be able to

- Enumerate architecture, components and various modules of ERP
- Apply ERP vendor selection process
- Describe ERP Project management

Course Contents

Unit I	**Introduction**	**06 Hrs**
	Defining ERP, Functional Modules, Common Myths, Evolution of ERP, characteristics of ERP, Process Integration with ERP, Benefits of ERP, Technology behind ERP, Implementation costs, Justifying Investments ERP Market and Vendors, SaaS, IaaS, PaaS, Cloud ERP Extended ERP services – SCM, CRM, PLM, GIS Related Technologies – Data Warehousing, Mining, OLAP, Business Intelligence (BI), Business Analytics (BA)	
Unit II	**ERP Planning**	**06 Hrs**
	Planning for ERP – Understanding organizational requirements, Project scope and broad implementation approach, determining resources, top management and organizational commitment, matching business processes with ERP, ERP Package evaluation and selection, creating Budget, ERP deployment models, preparing organization for implementation	
Unit III	**ERP Implementation**	**06 Hrs**
	Designs of ERP systems, Implementation approaches, Risks/failure factors, Mitigating Implementation risks – Critical success factors, ERP implementation life cycle, Data migration, organization of ERP Implementation team, performance measurement, Management and complexity of Large-scale ERP Projects, User Training, Evaluating ERP projects, Case study of ERP implementation	
Unit IV	**ERP: Going Live and Post Management**	**06 Hrs**
	Preparing to Go Live, strategies for migration to new ERP systems, performance measurement surprises, Managing ERP after Go Live, Maintenance of ERP system	

Unit V		06 Hrs
	ERP and E-business – E-business supply chain integration, ERP/E-business integration, Bringing ERP to the entire enterprise, Service-Oriented Architecture, Enterprise Application Integration (EAI), Application Service Provider model for ERP Implementation	

Reference Books:

1. Enterprise Resource Planning, Ashim Raj Singla, Cengage Learning publishers
2. Enterprise Resource Planning, Alexis Leon, 3rd Ed, McGraw Hill education
3. ERP In Practice (ERP strategies for steering organizational competence and competitive advantage), Jagan Nathan Vaman, McGraw Hill
4. ERP Systems for Manufacturing Supply Chains: Applications, Configuration, and Performance, Odd Jøran Sagegg, Erlend Alfnes, CRC Press

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 663B MJ: Information Security

Teaching Scheme:	**Credits**	**Examination Scheme:**
Theory: 2 Hrs./Week	**02**	**Continuous Evaluation: 15 Marks** **End-Semester : 35 Marks**

Course Objectives

- To understand the fundamental principles and concepts in Information Security
- To acquire the knowledge of cryptography
- To learn standard algorithms and protocols employed to provide confidentiality, integrity and authenticity
- To acquire the knowledge of security protocol deployed in web security
- To study Information Security tools

Course Outcomes

After successful completion of the course, students will be able to

- Identify cyber security threats and apply formal procedures to defend the attacks
- Apply appropriate cryptographic techniques
- Analyze web security solutions
- Identify and Evaluate Information Security threats and vulnerabilities in Information systems
- Demonstrate the use of standards and cyber laws to enhance Information Security

Course Contents

Unit I	**Introduction to Information Security**	**06 Hrs**
	Foundations of Security, Computer Security Concepts, The OSI Security Architecture, Security attacks, Security services, Security mechanism, A Model for Network Security Introduction to Tools: Clam AV antivirus engine, Anti Phishing, Anti Spyware	
Unit II	**Cryptography**	**06 Hrs**
	Number theory: Prime number, Fermat and Euler theorems , Testing for primality, Chinese reminder theorem, discrete logarithm, Public Key Cryptography and RSA, Key Management, Diffie- Hellman key exchange, El Gamal algorithm, Elliptic Curve Cryptography, introduction to crypt tool	
Unit III	**Data Integrity Algorithms And Web Security**	**06 Hrs**
	Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, MD4, MD5. **Message Authentication Codes**: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs. **Digital Signatures**: Digital Signatures, Schemes, Digital Signature	

	standard, PKI X.509 Certificate. Web Security issues, HTTPS, SSH, Email security: PGP, S/MIME, IP Security : IPSec, Introduction to Tools: Open SSL, Hash Calculator Tool : MD5, SHA1, SHA256, SHA 512	
Unit IV	**Network and System Security**	**06 Hrs**
	The OSI Security architecture, Access Control, Flooding attacks, DOS, Distributed DOS attacks Intrusion detection, Host based and network based Honeypot, Firewall and Intrusion prevention system, Need of firewall, Firewall characteristics and access policy, Types of Firewall, DMZ networks, **Intrusion prevention system:** Host based, Network based, Hybrid. Virtual Private Network (VPN) Operating system Security, Application Security, Security maintenance, Multilevel Security, Multilevel Security for role based access control, Concepts of trusted system, Trusted computing. Introduction to Tools: Wireshark, Windows Firewall, Snort, Linux iptables, Linux SELinux	
Unit V	**Cyber Security and Tools**	**06 Hrs**
	Introduction, Cybercrime and Information Security, Classification of Cybercrimes, The legal perspectives-Indian perspective, Global perspective, Categories of Cybercrime, Social Engineering, Cyber stalking, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and Cybercrime Scenario in India, Indian IT Act. Introduction to network security scanners: Nmap, Metasploit	

Reference Books:

1. William Stallings, “Cryptography and Network Security Principals and Practice”, Seventh edition, Pearson
2. William Stallings, Lawrie Brown, “Computer Security Principles and Practice”, 3rd_Edition, Pearson
3. Nina Godbole, Sumit Belapure, “Cyber Security”, Wiley
4. Atul Kahate, “Cryptography and Network Security”, 3e, McGraw Hill Education

SAVITRIBAI PHULE PUNE UNIVERSITY
SECOND YEAR M. Sc. (COMPUTER APPLICATIONS)
SEMESTER IV

CA 681 RP: Research Work - II

Teaching Scheme:	Credits	Examination Scheme:
Laboratory: 12 Hrs./Week	**06**	**Continuous Evaluation: 50 Marks** **End-Semester : 100 Marks**

Course Objectives

- To get first-hand experience to apply research methodology

Course Outcomes

After successful completion of the course, students will be able to

- Apply research methodology to carry out research in a chosen problem domain
- Design and develop a novel methodology / framework etc
- Conduct experiments and analyze results

Guidelines for carry out Research Work

Each student shall carry out the research work during semester IV under the guidance of the appointed faculty Advisor/Mentor. Preferably this work may be an extension of research work carried out by a student as a part of Research Work – I in Semester III. Students shall work on a research problem and publish a paper / file a copyright / patent based on the work carried out. The student shall prepare and submit a report based on the work carried out consisting of – Face Page, certificate, Acknowledgement, Abstract, Table of Contents, List of Tables, List of Figures, Abbreviations, and separate Chapters dealing with Introduction, Literature Review, Design details of Proposed System, Experimental Results and analysis, and a chapter providing Conclusions and future scope. List of Publications, Copyright/patent, references and appendix shall also be included in the report.

Guidelines for Assessment

The work carried out shall be evaluated on a continuous basis by the assigned faculty advisor / mentor for 50 marks and panel of examiners appointed shall evaluate the work based on the report for 100 marks.