



Savitribai Phule Pune University
(Formerly University of Pune)

Two Year Master's Degree Program in Information Technology
(Faculty of Science & Technology)

Revised Syllabi for

M.Sc.(Information Technology) Sem-I

(For Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System(CBCS) Syllabus
Under National Education Policy (NEP)
To be implemented from Academic Year 2023-2024

Savitribai Phule Pune University

M.Sc.(Information Technology)

(To be implemented from Academic year 2023-2024 as per NEP)

Preamble:

The Master of Science in Information Technology, (M.Sc. IT), is designed to give deep and comprehensive knowledge in the field of Information Technology. The goal of this program is to promote students in understanding theoretical knowledge, practical skill, research work, recent developments and cutting-edge technologies to make a global impact through their careers in IT. It aims to make students global competent and be future ready. With strong importance on academic excellence and research oriented learning, the M.Sc. IT program seeks to foster a community of skilled I.T. professionals capable of addressing complex challenges across various industries.

M.Sc. (IT) is a Two Years Full Time Degree program divided into four semesters. The program will be as per National Education Policy comprising 88 credit points.

Eligibility:

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

Programme Outcomes:

- PO1. To inculcate extensive knowledge of various areas like Emerging Technology, Advance Network and communication technologies, Modern operating System, Information Assurance and Security.
- PO2. To understand the concepts and applications in the field of Information Technology like Web designing and development, Mobile application development.

- PO3. To enable students to contribute in research work by applying innovative ideas to solve real world problems and to develop critical thinking power.
- PO4. To gain advanced and in-depth knowledge of Information Technology and its applications.
- PO5. To enable students, pursue a professional career in Information and Communication Technology in related industry, business and research.
- PO6. To enable students to excel in multidisciplinary sectors.
- PO7. The Program also includes On Job training, Internship, Research work, Research article and paper writing or a thesis that excels students with practical experience and to solve real world problems.
- PO8. To prepare students to meet the information and communication technology needs of private and government sectors.
- PO9. To contribute in the success of organizations through adopting a lifelong process of research, adaptation, and implementation of technology.
- PO10. To prepare students who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, design and implementation skills.

M.Sc.(Information Technology) Structure as per NEP Guidelines

SEMESTER I

Course Type	Course code	Course Name	Credits		Teaching Scheme Hrs/Week		Examination Scheme and Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core	IT-501-MJ	Modern Operating System	4	-	4	-	30	70	100
	IT-502-MJ	.Net Programming	4	-	4	-	30	70	100
	IT-503-MJ	Object Oriented Software Engineering	2	-	2	-	15	35	50
	IT-504-MJP	Lab course on Modern Operating System	-	2	-	4	15	35	50
	IT-505-MJP	Lab course on .Net Programming	-	2	-	4	15	35	50
Major Elective	IT-510-MJ	Advance Mobile Technology	2	-	2	-	15	35	50
	IT-511-MJP	Lab course on Advance Mobile Technology	-	2	-	4	15	35	50
	OR								
	IT-512-MJ	Web Technology	2	-	2	-	15	35	50
	IT-513-MJP	Lab course on Web Technology	-	2	-	4	15	35	50
	OR								
	IT-514-MJ	Database Technology	2	-	2	-	15	35	50
IT-515-MJP	Lab Course on Database Technology	-	2	-	4	15	35	50	
RM	IT-531-RM	Research Methodology (General/Subject Specific)	4	-	4	-	30	70	100
Total			16	6					

SEMESTER II

Course Type	Course code	Course Name	Credits		Teaching Scheme Hrs/Week		Examination Scheme and Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core	IT-551-MJ	Artificial Intelligence	4	-	4	-	30	70	100
	IT-552-MJ	Emerging Technology	4	-	4	-	30	70	100
	IT-553-MJ	Advance Networking	2	-	2	-	15	35	50
	IT-554-MJP	Lab course on Artificial Intelligence	-	2	-	4	15	35	50
	IT-555-MJP	Lab course on Emerging Technology	-	2	-	4	15	35	50
Major Elective	IT-560-MJ	Angular JS	2	-	2	-	15	35	50
	IT-561-MJP	Lab Course on Angular JS	-	2	-	4	15	35	50
	OR								
	IT-562-MJ	Digital Marketing	2	-	2	-	15	35	50
	IT-563-MJP	Lab Course on Digital Marketing	-	2	-	4	15	35	50
	OR								
	IT-564-MJ	Blockchain Technology	2	-	2	-	15	35	50
IT-565-MJP	Lab course on Blockchain Technology	-	2	-	4	15	35	50	
On Job Training	IT-581-OJT	On Job Training in IT industry/Summer Project (120Hours)	-	4	-	-	30	70	100
Total			12	10					

SEMESTER III

Course Type	Course code	Course Name	Credits		Teaching Scheme Hrs/Week		Examination Scheme and Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core	IT-601-MJ	Machine Learning	4	-	4	-	30	70	100
	IT-602-MJ	Information Assurance & Security	4	-	4	-	30	70	100
	IT-603-MJ	Data Analytics	2	-	2	-	15	35	50
	IT-604-MJP	Lab course on Machine Learning	-	2	-	4	15	35	50
	IT-605-MJP	Lab course on Information Assurance & Security	-	2	-	4	15	35	50
Major Elective	IT-610-MJ	NODEJS	2	-	2	-	15	35	50
	IT-611-MJP	Lab Course on NODEJS	-	2	-	4	15	35	50
	OR								
	IT-612-MJ	Cloud Computing	2	-	2	-	15	35	50
	IT-613-MJP	Lab Course on Cloud Computing	-	2	-	4	15	35	50
	OR								
	IT-614-MJ	Cryptocurrency Technologies	2	-	2	-	15	35	50
IT-615-MJP	Lab Course on Cryptocurrency Technologies	-	2	-	4	15	35	50	
Research Project	IT-631-RP	Research Project Work Research Paper in Conference	-	4	-	-	30	70	100
		Total	12	10					

Guidelines for Research Work (IT-631-RP):

- Students is expected to do the research work under the guidance of mentor assigned and to present by any one of the following:
 1. Presentation of the Research Paper in Conference.
 2. Publication in peer reviewed/UGC care Journal.
 3. Active participation and project Presentation in recognized research project competition.

SEMESTER IV

Course Type	Course code	Course Name	Credits		Teaching Scheme Hrs/Week		Examination Scheme and Marks		
			TH	PR	TH	PR	CE	EE	Total
Major Core	IT-651-MJP	Full Time Industrial Training(IT)	-	12	-	-	90	210	300
Major Elective	IT-652-MJ	MOOC Courses	4	-	-	-	30	70	100
	OR								
	IT-652-MJ	Any Two from following through online mode each of 2 credits	4	-	-	-	30	70	100
		- Virtual Reality							
		- Data Mining & Warehousing							
		- Soft Computing							
		- IT Infrastructure & Management							
Research Project	IT-681-RP	Thesis/Dissertation on IT	-	2	-	-	45	105	150
	IT-681-RP	Research Work/ Research paper in Journal	-	4	-	-			
Total			4	18					

Abbreviations

IT	Information Technology		MJ	Major Theory
RM	Research Methodology		MJP	Major Practical
OJT	On Job Training		RP	Research Project
TH	Theory		PR	Practical
CE	Continuous Evaluation		EE	End semester Evaluation
MOOC	Massive Open Online Course			

Guidelines for Full Time Industrial Training (IT-651-MJP):

- Each student must complete the full time Industrial training in industry or institution during the semester for 360 hours.
- Students should submit a valid offer letter and synopsis within two weeks of starting the training
- College should assign a mentor to the group of 10 students.
- The mentor will monitor the progress of the students throughout the semester for continuous assessment.
- The students have to submit the monthly progress report time to time.
- There will be continuous assessment of the work done by the students during the period by the mentor assigned.
- The final presentation on the worked carried during the semester will be evaluated by the examination panel.

Guidelines for Research Work (IT-681-RP):

- Thesis/Dissertation/Project Report on Full Time Industrial Training MIT-2201
 - Students should prepare the thesis on the work carried during Industrial Training.
 - The documentation in the thesis will be evaluated by the examination panel.
- Research Paper(4 Credits)
 - Student should do the research work under the supervision of mentor assigned.
 - The research work is to be published in Peer reviewed or UGC care Journal.

Research Project

Research Project will consist of 2 parts:

- I. The Research Proposal
- II. The actual dissertation or Research Project Report

I. The Research Proposal

Students are required to submit their research ideas in the form of a research proposal to their supervisors / advisors / guides and get approval from the guide before the actual research work starts.

Format of Research Proposal (RP)

- Project Title
- Introduction and Origin of the research problem
- Interdisciplinary relevance
- Review of Research and Development in the Subject
- National / International status
- Significance of the study - Objective, methodology
- Approximate time by which each stage will be completed
- Expected results and the outcome of the research project
- Bibliography

Following can be used as a guide to evaluate a RP

- ***Does the proposal address a well-formulated problem?*** Have research gaps been identified.
- ***Is it a research problem***, or is it just a routine application of known techniques?
- ***Do the proposers have a good idea on which to base their work?*** The proposal must explain the idea in sufficient detail to convince the reader that the idea has some substance, and should explain why there is reason to believe that it is indeed a good idea.
- ***Does the proposal explain clearly what work will be done?*** Does it explain what results are expected and how they will be evaluated? How would it be possible to judge whether the work was successful?
- ***Is there evidence that the proposers know about the work that others have done on the problem?*** This evidence may take the form of Literature Review or a short review as well as representative references.

The proposal should answer three key questions:

1. What are we going to learn as the result of the proposed project that we do not know now?
2. Why is it worth knowing?
3. How will we know that the conclusions are valid?

II. The Research Project

Students should submit a proper research dissertation at the end of their research work for the required credits.

Format of Research Project:

- Title of Research
- Certificate
- Index
- List of Figures
- List of Tables
- Publications
- Introduction - Objectives of the Research
- Literature Review of previous research in the area and justification / Importance /Value of further research, Data, Scope and Limitations
- Actual Work Done with Experimental Setup, if any.
- Results and Discussion
- Future scope of research
- Bibliography in format –Author name, title, publication details , year

Sem-I

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem - I

Course code: IT-501-MJ
Course Title: Modern Operating System

No. of Credits: 04

Total Hours: 60

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

1. Processes and Thread Scheduling by operating system.
2. Memory management by operating system.
3. Design issues related to file management and various related algorithms.
4. Synchronization in process and threads by operating system.
5. Deadlock handling by operating system.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Introduction to Operating System 1.1 Definition of Operating System, Functions of operating systems 1.2 Operating Systems View by – User View, System View, 1.3 Operating System services 1.4 Operating System Structure – Simple structure, Layered approach, Micro kernels 1.5 Computer Environment – Traditional computing, Client server computing, Peer to peer Computing , Open source operating System 1.6 Protection and security 1.7 System calls with its types like Process control, File management, Device management, etc.	04	CO1
2	Process management and Threads 2.1 Process Concept – The process, Process states, Process control block. 2.2 Process Scheduling – Scheduling queues, Schedulers, context switch 2.3 Operations on Process – Process creation with program using fork(), Process termination 2.4 Threads – concept of threads and multi threading.	04	CO1
3	Process Scheduling 3.1 Basic Concept – CPU-I/O burst cycle, CPU scheduler, Preemptive scheduling, Dispatcher 3.2 Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round-robin scheduling, Multiple queue scheduling	10	CO1
4	Process Synchronization 4.1 Background 4.2 Critical Section Problem	10	CO4

	4.3 Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem, The dining philosopher problem		
5	Memory Management 5.1 Background – Basic hardware, Address binding, Logical versus physical address space, Dynamic loading, Dynamic linking and shared libraries 5.2 Swapping 5.3 Contiguous Memory Allocation – Memory mapping and protection, Memory allocation, 5.4 Virtual Memory Management – Background, Demand paging, Performance of demand paging, Page replacement – FIFO, Optimal, LRU, MFU	12	CO2
6	Deadlocks 6.1 System model 6.2 Deadlock Characterization – Necessary conditions, Resource allocation graph 6.3 Deadlock Prevention 6.4 Deadlock Avoidance - Safe state, Resource allocation graph algorithm, Banker’s Algorithm 6.5 Deadlock Detection 6.6 Recovery from Deadlock – Process termination, Resource preemption	10	CO5
7	File System 7.1 File concept 7.2 Access Methods – Sequential, Direct 7.3 Directory and Disk Structure – Storage structure, Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic graph directory, General graph directory 7.4 Allocation Methods – Contiguous allocation, Linked allocation, Indexed allocation 7.5 Free Space Management – Bit vector, Linked list, Grouping, Counting	10	CO3

References Books:

1. Operating System Concepts - Siberchatz, Galvin, Gagne (8th Edition).
2. Operating Systems: Internals and Design Principles, William Stallings, Prentice Hall of India.
3. Advanced Concepts in Operating Systems, M Singhal and NG Shivaratri, Tata McGraw Hill Inc, 2001
4. The ‘C’ Odyssey, UNIX-the open boundless C, Meeta Gandhi, Tilak Shetty, Rajiv Shah, BPB publication
5. Operating Systems : Principles and Design – Pabitra Pal Choudhary (PHI Learning Private Limited)

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem - I

Course code: IT-502-MJ
Course Title: .Net Programming

No. of Credits: 04

Total Hours: 60

Course Outcome: On completion of the course, student will be able to understand,

1. Use the features of Dot Net Framework along with the features of C# and ASP.
2. Design, Develop and Deployment of window based .NET applications.
3. Design and Implement database connectivity using ADO.NET.
4. Build an ASP.Net web application using various controls of ASP.Net.
5. Design web application to perform basic operations (insert, delete, select and update)using ADO.Net.
6. Managing state using various techniques of ASP.Net.
7. Customize web pages using Master Page, Themes and Skins.
8. Creating and using Web services.

Chapter No.	Content	No. of Hours	CO Targeted
1	DOTNET Framework: 1.1 Introduction to DOTNET 1.2 DOT NET class framework 1.3 Common Language Runtime 1.4 Common Language Integration	2	CO1
2	Introduction to C# and Object-Oriented Concepts in C#: 2.1 Language features: Variables and Expressions, type conversion, Flow Control, Functions, Delegates, Debugging and error handling, exception handling 2.2 Object Oriented Concepts: Defining classes, class members, Interfaces, properties, Access modifiers, Implementation of class, interface and properties, Concept of hiding base class methods, Overriding, Event Handling 2.3 Collections, Comparisons and Conversions: Defining and using collections, Indexers, iterators, Type comparison, Value Comparison, Overloading Conversion operators, as operator	9	CO1

3	Graphical user interface in C#: 3.1 Window Controls: Common Controls, Container Controls, Menus and Toolbars, Printing, Dialogs 3.2 Deploying Window Application: Deployment Overview, Visual studio setup and Deployment project types, Microsoft windows installer architecture, Building the project : Installation	9	CO2
4	Connected and Disconnected Architecture of ADO.Net: 4.1 Basics of Ado.net 4.2 Connection Object 4.3 Command Object 4.4 Dataset, DataTable, Data Reader Object 4.5 Data Adapter Object 4.6 Datagridview Data Binding: Insert, Update, Delete records 4.7 Traversing Using Data Source	8	CO3
5	Assemblies in .NET: 5.1 Components 5.2 NET Assembly features 5.3 Structure of Assemblies 5.4 Calling assemblies, private and shared assemblies	3	CO2
6	Introduction to ASP.NET: 6.1 Web application fundamentals 6.2 Forms, HTML forms, Web Pages, Webforms 6.3 ASP.NET MVC 6.4 ASP.NET features 6.5 ASP.NET lifecycle	3	CO4
7	Variables, Control Structures & Functions: 7.1 Request & Response in Non-ASP.NET pages 7.2 Datatypes: Numeric, Text, Arrays, Data Collections 7.3 Control structures 7.4 Functions: web controls as parameters	4	CO4
8	ASP.NET Server Controls: 8.1 HTML Server Controls 8.2 Web Forms Server Controls 8.3 Rich Controls 8.4 Validation Controls 8.5 User Controls	5	CO4
9	Event Driven Programming andPostBack : 9.1 HTML events 9.2 ASP.NET page events 9.3 ASP.NET Web control events 9.4 Event driven programming and postback	4	CO4

10	Reading from Databases (ADO.NET and LINQ): 10.1 ADO.NET Overview 10.2 NET Data Providers 10.3 Connections 10.4 Commands 10.5 Data Readers and Connected Access 10.6 Data Sets and Disconnected Access 10.7 Language Integrated Query Basics	4	CO5
11	ASP.Net State Management: 11.1 View State 11.2 Hidden Form Field 11.3 Query String 11.4 Cookies 11.5 Sessions 11.6 Application	2	CO6
12	Customizing Web Application: Master Page, Themes and Skins: 12.1 Introduction to Master Page 12.2 Content Placeholder and Content tags 12.3 Accessing controls of MasterPage in ContentPage 12.4 Use Themes and Skins to Customize a site	4	CO7
13	Web Services: 13.1 Building ASP.NET web service and consuming a web service	2	CO8

Reference Books:

1. Beginning Visual C#, Wrox Publication
2. Professional Visual C#, Wrox Publication
3. Programming in C# ,E. Balagurusamy
4. ADO.NET Examples and Best Practices for C# Programmers, By Peter D, Blackburn, William
5. Beginning ASP.NET 3.5, Wrox Publication
6. Professional ASP.NET 4.5 in C# and VB, Wrox Publication, Jason N. Gaylord, Christian Wenz, Pranav Rastogi, Todd Miranda, Scott Hanselman, Scott Hunter
7. Matthew Macdonald and Robert Standefer, "ASP.NET Complete Reference", TataMcGrawHills.
8. Programming Microsoft®LINQ in Microsoft .NET Framework 4- Marco Russo and Paolo Pialorsi

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem- I

Course code: IT-503-MJ

Course Title: Object Oriented Software Engineering

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. The object oriented modeling and development concepts.
2. Studying UML models.
3. Studying object oriented development process.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Object Oriented Concepts and Introduction to UML 1.1 What is Object Orientation? (Introduction to class, Object, inheritance, polymorphism) 1.2 Model 1.2.1 Importance of Modeling 1.2.2 Object Oriented Modeling 1.3 Identifying the elements of an object model 1.3.1 Identifying classes and objects 1.3.2 Specifying the attributes 1.3.3 Defining operations 1.3.4 Finalizing the object definition 1.4 Overview of UML 1.5 Conceptual Model of UML	6	CO1
2	Basic and Advanced Structural Modeling 2.1 Class diagram: Classes, Relationship, Common mechanism. 2.2 Object Diagram : Interface, Types and Roles, Packages (Atleast 2 case studies)	4	CO2
3	Basic Behavioral Modeling 3.1 Use Case Diagram 3.2 Interaction Diagram 3.3 Activity Diagram 3.4 State chart Diagram (Atleast 2 case studies)	6	CO2
4	Architectural Modeling 4.1 Components Diagram 4.2 Deployment Diagram (Atleast 2 case studies)	2	CO2

5	Object Oriented Design 5.1 Generic components of OO Design model 5.2 System Design process 5.3 Object Design process	4	CO2
6	Object Oriented Analysis 6.1 Iterative Development 6.2 Unified process and unified Process Phases 6.2.1 Inception 6.2.2 Elaboration 6.2.3 Construction 6.2.4 Transition 6.3 Understanding requirements 6.4 Unified process Disciplines 6.5 Agile Unified process	4	CO3
7	Object Oriented Testing 7.1 Object oriented Testing 7.2 Types of Testing 7.3 Object oriented Testing strategies 7.4 Test case design for Object Oriented software 7.5 Inter class test case design	4	CO3

References Books:

1. The Unified Modeling Language User Guide by Grady Booch, James Raumbaugh, Ivar Jacobson.
2. Object Oriented Software Engineering by Ivar Jacobson
3. Software Engineering by Pressman
4. Applying UML and Patterns by Craig Larman

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem - I

Course code: IT-504-MJP

Course Title: Lab course on Modern Operating System

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Process synchronization.
2. Processes and Thread Scheduling by operating system.
3. Memory management by operating system using with the help of various schemes.

List of Assignments:

1. Implement the C Program to create a child process using fork(), display parent and child process id. Child process will display the message “I am Child Process” and the parent process should display “I am Parent Process”.
2. Write a program that demonstrates the use of nice() system call. After a child process is started using fork(), assign higher priority to the child using nice() system call.
3. Implement the C program to accept n integers to be sorted. Main function creates child process using fork system call. Parent process sorts the integers using bubble sort and waits for child process using wait system call. Child process sorts the integers using insertion sort.
4. Write a C program to illustrate the concept of orphan process. Parent process creates a child and terminates before child has finished its task. So child process becomes orphan process. (Use fork(), sleep(), getpid(), getppid())
5. Write a C program that behaves like a shell which displays the command prompt ‘myshell\$’. It accepts the command, tokenize the command line and execute it by creating the child process. Also implement the additional command ‘count’ as
myshell\$ count c filename: It will display the number of characters in given file
myshell\$ count w filename: It will display the number of words in given file
myshell\$ count l filename: It will display the number of lines in given file
6. Write a C program that behaves like a shell which displays the command prompt ‘myshell\$’. It accepts the command, tokenize the command line and execute it by creating the child process. Also implement the additional command ‘list’ as
myshell\$ list f dirname: It will display filenames in a- given directory.
myshell\$ list n dirname: It will count the number of entries in a given directory.
myshell\$ list i dirname: It will display filenames and their inode number for the files in a given directory.
7. Write the program to simulate FCFS CPU-scheduling. The arrival time and first CPUburst for different n number of processes should be input to the algorithm. Assume that the fixed IO waiting time (2 units). The next CPU-burst should be generated randomly. The output

should give Gantt chart, turnaround time and waiting time for each process. Also find the average waiting time and turnaround time.

8. Write the program to simulate Non-preemptive Shortest Job First (SJF) -scheduling. The arrival time and first CPU-burst for different n number of processes should be input to the algorithm. Assume the fixed IO waiting time (2 units). The next CPU-burst should be generated randomly. The output should give Gantt chart, turnaround time and waiting time for each process. Also find the average waiting time and turnaround time
9. Write the program to simulate Preemptive Shortest Job First (SJF) -scheduling. The arrival time and first CPU-burst for different n number of processes should be input to the algorithm. Assume the fixed IO waiting time (2 units). The next CPU-burst should be generated randomly. The output should give Gantt chart, turnaround time and waiting time for each process. Also find the average waiting time and turnaround time.
10. Write the program to simulate Non-preemptive Priority scheduling. The arrival time and first CPU-burst and priority for different n number of processes should be input to the algorithm. Assume the fixed IO waiting time (2 units). The next CPU-burst should be generated randomly. The output should give Gantt chart, turnaround time and waiting time for each process. Also find the average waiting time and turnaround time.
11. Write the simulation program to implement demand paging and show the page scheduling and total number of page faults for the following given page reference string. Give input n as the number of memory frames.
Reference String : 12,15,12,18,6,8,11,12,19,12,6,8,12,15,19,8
1) Implement FIFO 2) Implement LRU
12. Write the simulation program to implement demand paging and show the page scheduling and total number of page faults for the following given page reference string. Give input n as the number of memory frames.
Reference String : 12,15,12,18,6,8,11,12,19,12,6,8,12,15,19,8
1) Implement OPT 2) Implement MFU

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

M.Sc.(Information Technology)

Sem - I

Course code: IT-505-MJP

Course Title: Lab Course on .Net Programming

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Design and Implement database connectivity using ADO.NET.
2. Design web application to perform basic operations (insert, delete, select and update)using ADO.Net.
3. Creating and using Web services.

Lab Assignments:

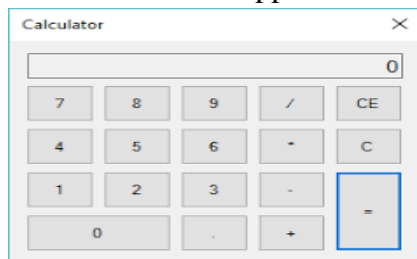
Topic Name & Assignments

C# Introduction

1. Write a C# program to find whether a given number is even or odd.
2. Write a C# program to find the largest of three numbers.
3. Write a C# Sharp program to perform basic arithmetic operations.
4. Write a C# program to sort an array in descending order.
5. Write a C# program to find min number in an array. Accept 10 numbers from user
6. Write a C# program to perform addition of two 3*3 matrix.

OOPs Concepts:

7. Write a C# program which will explain multilevel inheritance.
8. Write a C# program which will explain function overloading and function overriding.
9. Write a C# the program will explain the use of Collection.
10. Write a C# application that will take an input from a user and throw an exception if the number is greater than 10000.
11. Write a C# application to handle divide by zero error.
12. Create a windows application to perform following basic arithmetic operations.



Database Connectivity using ADO.Net:

13. Write a C# windows application to perform insert,select,delete and update operation.

Note: Consider the **student** table to perform above operations.Use both Connected and disconnected architecture.

Assembly:

14. Write a C# application which will demonstrate the use of private,public and shared assembly.

ASP.Net:

15. Write an ASP.Net application to explain use of various controls.

16. Write an ASP.Net application to explain use of all validation controls.

Event Driven Programming andPostBack :

17. Write an ASP.Net application to make the use of events.

Reading from Databases (ADO.NET):

18. Do assignment number 13 using connected and disconnected architecture of ASP.Net.

ASP.Net State Management:

19. Write an ASP. Net application to explain the use of the state management concept.

Customizing Web Application: Master Page , Themes and Skins:

20. Create an ASP.Net web application to explain the use of master page.

21. Create an ASP.Net web page and customize that webpage making the use of Themes and skins.

Web Services:

22. Create an ASP.net application to explain the use of web services in ASP.Net

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - I

Course code: IT-510-MJ
Course Title: Advanced Mobile Technologies

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Gain knowledge about different mobile platform and application development.
2. To know the programming using Android and Windows platform
3. To gain knowledge of installing Android Studio and Cross Platform Integrated Development Environment.
4. An ability to use the techniques, skills, and modern technology.
5. Understanding of the specific requirements, possibilities and challenges when developing for a mobile context.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Introduction to Android 1.1 What is Android? 1.2 Android Architecture 1.3 Basic Building blocks - Activities, Services, Broadcast Receivers & Content providers 1.4 Android API levels (versions & version names) 1.5 Setting up development environment 1.6 AndroidManifest.xml 1.7 Emulator-Android Virtual Device 1.8 Resources & R.java, Assets 1.9 Activities and Activity lifecycle 1.10 First sample Application	04	CO3,CO4
2	Basic UI design 2.1 Basic UI Designing (Form widgets ,Text Fields , Layouts ,[dip, dp, sip, sp] versus px) 2.2 All components (e.g Button , Slider,Image view, Toast) Event Handling 2.3 Components for communication -Intents & Intent Filters 2.4 Adapter 2.5 Menu 2.6 Time and Date picker 2.7 Images and media 2.8 Toast 2.9 Dialog Box	08	CO2,CO3, CO4

4	Content Providers 4.1 SQLite Programming 4.2 SQLiteOpenHelper 4.3 SQLiteDatabase 4.4 Cursor 4.5 Reading and updating Contacts 4.6 JSON Parsing 4.7 Accessing Phone Service(Call, SMS, MMS) 4.8 Location based services	05	CO2,CO3, CO4
5	Introduction to React Native 5.1 What is React Native? 5.2 What does it do for us? Why choose it? 5.3 Pros and cons 5.4 Architecture 5.5 Sharing with web projects 5.6 What React Native code looks like 5.7 Creating React Environment	04	CO1,CO5
6	UI for React Native App 6.1 Adding Styles to the Elements 6.2 Toggle Buttons 6.3 List Items 6.4 Flexbox to create a Layout 6.5 Navigation setup 6.6 Developing Reusable button 6.7 Including Custom Fonts and Icons 6.8 Orientation Change Detection 6.9 Webview to embed external websites 6.10 Creating a Form Component	05	CO1,CO5
7	The Development Process 7.1 React-Native vs. Create-React-Native app 7.2 The React Native team's recommendations 7.3 What is expo? 7.4 Creating a new React Native app 7.5 How to run it on a wireless device 7.6 How to run it in an Android emulator	04	CO5

References Books:

1. Beginning Android Application Development by Wei-Meng Lee Wiley
2. React Native for Mobile Development by Akshat Paul and Abhishek Nalwaya

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - I

Course code: IT-511-MJP
Course Title: Lab Course on Advanced Mobile Technologies

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. To gain knowledge of installing mobile platform, application development, Android Studio and Cross Platform Integrated Development Environment.
2. Understanding of the specific requirements, possibilities and challenges when developing for a mobile context.

Lab Assignments:

1. Create a Simple Application which shows the Life Cycle of Activity.
2. Create a Simple Application Which Send —Hello! message from one activity to another with help of Button (Use Intent).
3. Create an Android Application to accept two numbers and find power and Average. Display the result on the next activity on Button click.
4. Create an Android App with Login Screen. On successful login, gives message go to next Activity (Without Using Database& use Table Layout).
5. Create an Android Application that Demonstrate Alert Dialog Box.
6. Create an Android Application to demonstrate the Simple calculator.
7. Create an application to demonstrate date and time picker.
8. Demonstrate Array Adapter using List View to display list of Country.
9. Create an Android application to demonstrate Progress Dialog Box using AsyncTask.
10. Construct an Android Application to accept a number and calculate Factorial and Sum of Digits of a given number using Context Menu.
11. Create a Android Application to demonstrate Vertical Scroll Bar.
12. Create an Android application that plays an audio(song) in the background. Audio will not be stopped even if you switch to another activity. To stop the audio, you need to stop the service.
13. Create an Android application to send email.
14. Create an android Application for performing the following operation on the table Customer (id, name, address, phno). (use SQLite database) i) Insert New Customer Details.ii) Show All the Customer Details on Toast Message.
15. Create an Android Application to perform Zoom In, Zoom Out operation and display Satellite view, on Google Map.
16. Create an Android Application that produces Notification.
17. Create a React Native mobile application to Implementing Google Map into the App.
18. Create a React Native mobile application to Implementing Audio Player and Image Carousel.

19. Create a React Native mobile application to Implementing Push Notification to the App.
20. Create a React Native mobile application to Implementing Browser Based Authentication.

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem- I

Course code: IT-512-MJ
Course Title: Web Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Using MVC based framework easy to design and handling the errors in dynamic website.
2. Create the effective web applications.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Jquery 1.1 Introducing jQuery 1.2 jQuery fundamentals 1.3 Creating the wrapped element set 1.4 Bringing pages to life with jQuery 1.5 Understanding the browser event models 1.6 The jQuery Event Model 1.7 Sprucing up with animations and effects.	6	CO1
2	XML b. What is XML? c. XML document Structure d. PHP and XML e. XML parser f. The document object model g. The simple XML extension h. Changing a value with simple XML	6	CO1
3	AJAX 3.1 Introduction of AJAX 3.2 AJAX web application model 3.3 AJAX –PHP framework 3.4 Performing AJAX validation 3.5 Handling XML data using php and AJAX Connecting database using php and AJAX	6	CO1
4	Web Services 4.1 Web Services: SOAP, 4.2 RPC Style SOAP, 4.3 Document style SOAP.	6	CO1

	4.4 WSDL, REST services, 4.5 JSON format, 4.6 What is JSON? 4.7 Array literals, Object literals, Mixing literals, JSON Syntax, JSON Encoding and Decoding, JSON versus XML.		
5	PHP framework CodeIgniter 5.1 CodeIgniter – Overview 5.2 Installing CodeIgnite Application Architecture MVC Framework 5.3 Basic concept of CodeIgniter, Libraries Working with databases Load external JS and CSS page & redirecting from controller 5.4 Adding JS and CSS , Page redirection. Loading dynamic data on page & session management 5.5 cookies management	6	CO2

References Books:

1. Programming PHP By Rasmus Lerdorf and Kevin Tatroe O'Reilly publication
2. Beginning PHP 5, Wrox publication
3. AJAX Black Book Kogent solution
4. Professional Codeigniter By Thomas Myer ,Wrox Publication,
5. Codeihniter 2 CookBook By Rob Foster ,PACKT Publication ,
6. JQuery CookBook, O'reilly Publication.

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem- I
Course code: IT-513-MJP
Course Title: Lab Course on Web Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Create the effective web applications.

Lab Assignments:

1. Write jQuery program to solve the following:
 - a) Limit character input in the textarea including count.
 - b) Based on check box, disable/enable the form submit button.
2. Add or append in paragraph text and also in the numbered(ordered) list in a given HTML document using jQuery selectors. [Hint : Use Append() method]
3. To insert text before and after an image using jQuery. [Hint:Use before() and after()]
4. Remove div section elements after clicking on button using jQuery. [Hint : Use #id selector]
5. Write a PHP Script to read 'BOOK.xml' file and print specific content of a file using DOM Document parser. 'Book.xml' file should contain following information with at least 5 records with values.BookInfo:Book NO, Book Name, Author Name, Price, Year.
6. Write PHP script to read "student.xml" file into simpleXML object. Display student details in tabular format. "student.xml" file should contain following information with at least 5 records with values. studentNo,studentName,Marks and Percentage.
7. Write a PHP script to read "Movie.xml" file and print all MovieTitle and ActorName of file using DOMDocument Parser. "Movie.xml" file should contain following information with at least 5 records with values. MovieInfoMovieNo, MovieTitle, ActorName ,ReleaseYear
8. Write AJAX program to read contact.dat file and print the contents of the file in a tabular format when the user clicks on print button. Contact.dat file should contain srno, name, residence number, mobile number, Address. [Enter at least 3 record in contact.dat file]
9. Write a Ajax program to search Student Name according to the character typed and display list using array.
10. Write Ajax program to fetch suggestions when is user is typing in a textbox. (eg like google suggestions. Hint create array of suggestions and matching string will be displayed)
11. Write Ajax program to get book details from XML file when user select a book name. Create XML file for storing details of book(title, author, year, price).
12. Create TEACHER table as follows TEACHER(tno, tname, qualification, salary). Write Ajax program to select a teachers name and print the selected teachers details.
13. Create a table student having attributes (rollno, name, class). Assume appropriate data types for the attributes. Using Codeigniter , connect to the database and insert minimum 5 records in it.
14. For the above table student, display all its records using Codeigniter.
15. Add a Javascript file in codeigniter. The javascript code should check whether a number is even or odd.

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem – I

Course Code: IT-514-MJ
Course Name: Database Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Provide an overview of the concept of NoSQL technology.
2. Provide a glimpse of the various types of NoSQL databases with its features, suitable use case.
3. Aware students with implementation of NoSQL databases.
4. Provide the knowledge of different operations that performed on NoSQL databases.

Chapter No	Course Contents	No. of Lectures	CO Targeted
1	<p>Introduction to NOSQL (Core concepts)</p> <p>1. Why NoSQL</p> <p>1.1 The Value of Relational Databases</p> <p>1.1.1 Getting at Persistent Data</p> <p>1.1.2 Concurrency</p> <p>1.1.3 Integration</p> <p>1.1.4 A (Mostly) Standard Model</p> <p>1.2 Impedance Mismatch</p> <p>1.3 Application and Integration Databases</p> <p>1.4 Attack of the Clusters</p> <p>1.5 The Emergence of NoSQL</p> <p>2. Aggregate Data Models</p> <p>2.1 Aggregates</p> <p>2.1.1 Example of Relations and Aggregates</p> <p>2.1.2 Consequences of Aggregate Orientation</p> <p>2.2 Key-Value and Document Data Models</p> <p>2.3 Column-Family Stores</p> <p>2.4 Summarizing Aggregate-Oriented Databases</p> <p>3 Data modeling details</p> <p>3.1 Relationships</p> <p>3.2 Graph Databases</p> <p>3.3 Schemaless Databases</p> <p>3.4 Materialized Views</p> <p>3.5 Modeling for Data Access</p> <p>4. Distribution Models</p>	10	CO1

	<ul style="list-style-type: none"> 4.1 Single Server 4.2 Sharding 4.3 Master-Slave Replication 4.4 Peer-to-Peer Replication 4.5 Combining Sharding and Replication 5. Consistency <ul style="list-style-type: none"> 5.1 Update Consistency 5.2 Read Consistency 5.3 Relaxing Consistency <ul style="list-style-type: none"> 5.3.1 The CAP Theorem 5.4 Relaxing Durability 5.5 Quorums 6. Version stamps <ul style="list-style-type: none"> 6.1 Business and System Transactions 6.2 Version Stamps on Multiple Nodes 7. Map-Reduce <ul style="list-style-type: none"> 7.1 Basic Map-Reduce 7.2 Partitioning and Combining 7.3 Composing Map-Reduce Calculations <ul style="list-style-type: none"> 7.3.1 A Two Stage Map-Reduce Example 7.3.2 Incremental Map-Reduce 		
2	<p>Implementation with NOSQL databases</p> <p>Key-Value Databases (Riak)</p> <ul style="list-style-type: none"> 1 What Is a Key-Value Store 2 Key-Value Store Features <ul style="list-style-type: none"> 2.1 Consistency 2.2 Transactions 2.3 Query Features 2.4 Structure of Data 2.5 Scaling 3 Suitable Use Cases <ul style="list-style-type: none"> 3.1 Storing Session Information 3.2 User Profiles, Preferences 3.3 Shopping Cart Data 4 When Not to Use <ul style="list-style-type: none"> 4.1 Relationships among Data 4.2 Multioperation Transactions 4.3 Query by Data 4.4 Operations by Sets 	04	CO2, CO3
3	<p>Document Databases (Mongodb)</p> <ul style="list-style-type: none"> 1 What Is a Document Database? 2 Features <ul style="list-style-type: none"> 2.1 Consistency 2.2 Transactions 2.3 Availability 	04	CO2, CO3

	<ul style="list-style-type: none"> 2.4 Query Features 2.5 Scaling 3 Suitable Use Cases 3.1 Event Logging 3.2 Content Management Systems, Blogging Platforms 3.3 Web Analytics or Real-Time Analytics 3.4 E-Commerce Applications 4 When Not to Use 4.1 Complex Transactions Spanning Different Operations 4.2 Queries against Varying Aggregate Structure 		
4	<p>Column-Family stores (Cassandra)</p> <ul style="list-style-type: none"> 1 What Is a Column-Family Data Store? 2 Features <ul style="list-style-type: none"> 2.1 Consistency 2.2 Transactions 2.3 Availability 2.4 Query Features 2.5 Scaling 3 Suitable Use Cases <ul style="list-style-type: none"> 3.1 Event Logging 3.2 Content Management Systems, Blogging Platforms 3.3 Counters 3.4 Expiring Usage 4 When Not to Use 	04	CO2, CO3
5	<p>Graph Databases</p> <ul style="list-style-type: none"> 1 What Is a Graph Database? 2 Features <ul style="list-style-type: none"> 2.1 Consistency 2.2 Transactions 2.3 Availability 2.4 Query Features 2.5 Scaling 3 Suitable Use Cases <ul style="list-style-type: none"> 3.1 Connected Data 3.2 Routing, Dispatch, and Location-Based Services 3.3 Recommendation Engines 4 When Not to Use 	04	CO2, CO3
6	<p>Performing CRUD Operations</p> <ul style="list-style-type: none"> 1. Introduction of CRUD operations 2. Creating Records <ul style="list-style-type: none"> 2.1 Creating Records in a Document-Centric Database 2.2 Using the Create Operation in Column-Oriented Databases 2.3 Using the Create Operation in Key/Value Maps 3. Accessing Data <ul style="list-style-type: none"> 3.1 Accessing Documents from MongoDB 3.2 Accessing Data from HBase 	04	CO4

	3.3 Querying Redis 4. Updating and Deleting Data 4.1 Updating and Modifying Data in MongoDB, HBase and Redis 4.2 Limited Atomicity and Transaction Integrity		
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Reference Books:

1. NoSQL Distilled by Pramod Sadalge, Martin Fowler, Pearson Education, Inc.
2. NoSQL for Dummies by Adam Fowler, A Wiley Brand
3. Professional NoSQL by Shashank Tiwari, Wrox Publication

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem – I

Course Code: IT-515-MJP

Course Name: Lab Course on Database Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Provide a glimpse of the various types of NoSQL databases with its features, suitable use case.
2. Provide the knowledge of different operations that performed on NoSQL databases.

Lab Assignments:

Aware students to any two NoSQL database technologies from given below and solve any two assignments.

1. Assignment 1 is based on MongoDB. (Document Database)
2. Assignment 2 is based on Neo4j. (Graph Database)
3. Assignment 3 is based on Cassandra (Column-Family stores)

Assignment 1

1. Downloading and Installation of MongoDB
2. Identify MongoDB environment
3. Using Mongo Shell
4. Configuration file in MongoDB
5. Database commands in MongoDB.
6. Connecting to the terminal – (‘mongo’ command)

Create any two collections and perform following queries on it –

(Eg. of collections :- Employee, Movie, Actor, Doctor, Student etc.)

1. Create Database (‘use’ command) & Create Collection (‘createCollection’ command) with atleast 4 files.
2. Insert atleast 10 records / documents in the collection , Insert multiple records. – (‘insert’ command)
3. Display the documents inserted in the collection.
4. Update record with given condition (‘update’)
5. Find the record in the collection. (‘find’ command)
6. Sort the record.(‘sort’ operator)
7. Delete record (‘remove’)

Assignment 2: Basic commands of Neo4j –

- 1 Create the databases as graph models. (Neo4j database)
2. Visualize the models after creation
3. Add more labels, relationships and properties
3. Return properties of nodes, Return the nodes labels, Return the relationships with its properties.

4. Delete all nodes, labels and relationships.

Assignment 3 : Cassandra query language shell (cqlsh)

Cassandra cqlsh basic commands

- Help command
- Capture command
- Consistency command
- Copy command
- Describe cluster command
- Describe table
- Create keyspace
- Describe keyspace
- Use
- Alter keyspace
- Drop keyspace
- Truncate
- Create index
- Drop index
- Create table
- Delete table
- Expand command
- Show command

References:

1. "MongoDB: The Definitive Guide" by Kristina Chodorow.
2. "The Little MongoDB Book" by Karl Seguin.
3. MongoDB Manual on website MongoDB.com
4. <http://nicholasjohnson.com/mongo/course/workbook/>
5. <https://neo4j.com/docs/operations-manual/current/tools/cypher-shell/>
6. <https://www.support.dbagenesis.com/post/neo4j-basic-commands>
7. <https://www.tutorialspoint.com/neo4j/index.htm>
8. <https://www.cloudduggu.com/cassandra/shell-commands/>
9. <https://data-flair.training/blogs/cassandra-shell-commands/>

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem – I

Course Code: IT-531-RM

Course Name: Research Methodology (General/Subject Specific)

No. of Credits: 04

Total Hours: 60

Course Outcome: On completion of the course, student will be able to understand,

1. Understand of the fundamental concepts of research, including the research process, research questions, hypotheses, and variables.
2. Conduct a comprehensive literature review to identify relevant studies, synthesize existing knowledge, and identify research gaps.
3. Identify research problems, formulate research questions, and design appropriate methodologies to address these problems
4. Identify and select appropriate research designs, such as experimental, observational, survey, qualitative, or mixed-methods, based on the research objectives.
5. Apply appropriate data analysis methods, including statistical techniques or qualitative analysis, to draw meaningful conclusions from research data.
6. Develop a well-structured research proposal, outlining research questions, methodology, expected outcomes, and a rationale for the study.
7. Communicate research findings effectively through written reports, presentations, and academic papers.
8. Gain an appreciation for the importance of research in contributing to the advancement of knowledge in their field of study and broader society.
9. Understand the principles of research ethics and integrity

Chapter No	Course Contents	No. of Lectures	CO Targeted
1	Introduction to Research Methodology 1.1 Meaning of Research 1.2 Objectives of Research 1.3 Motivation in Research 1.4 Types of Research 1.5 Research Approaches 1.6 Significance of Research 1.7 Researcher and Characteristics of Researcher 1.8 Research Ethics and Integrity 1.9 Plagiarism and types of plagiarism 1.10 Introduction to Plagiarism check tools 1.11 Research Methods versus Methodology	10	CO1 CO9

	1.12 Research and Scientific Method 1.13 Importance of Knowing How Research is Done 1.14 Criteria of Good Research		
2	Literature Review and Formulation of Research Problems 2.1 Research Process 2.2 Reviewing the literature: purpose of a literature review 2.3 Literature resources 2.4 The Internet and a literature review 2.5 The Internet and research strategies and methods 2.6 Conducting and Evaluating literature reviews 2.7 Formulation of research problem 2.7.1 What is a Research Problem? 2.7.2 Selecting the Problem 2.7.3 Necessity of Defining the Problem 2.7.4 Technique Involved in Defining a Problem	6	CO1, CO2, CO3
3	Research Design 3.1 Meaning of Research Design 3.2 Need for Research Design 3.3 Features of a Good Design 3.4 Important Concepts Relating to Research Design 3.5 Different Research Designs/Methods 3.5.1 Pure and Applied Research 3.5.2 Exploratory or Formulative Research 3.5.3 Descriptive Research 3.5.4 Diagnostic Research 3.5.5 Evaluation Studies 3.5.6 Action Research 3.5.7 Experimental Research 3.5.8 Analytical Study or Statistical Method 3.5.9 Historical Research 3.5.10 Surveys 3.5.11 Case Study 3.5.12 Field Studies	8	CO3, CO4
4	Hypothesis and Sampling 4.1 What is Hypothesis? 4.2 Nature & Characteristics of Hypothesis 4.3 Significance of Hypothesis 4.4 Types of Hypothesis 4.5 Sources of Hypothesis 4.6 Characteristics of Good Hypothesis 4.7 What is sampling? 4.8 Aims of Sampling 4.9 Characteristics of Good Sample 4.10 Basis of Sampling 4.11 Merits and demerits of Sampling 4.12 Sampling Techniques or Methods	10	CO5, CO6

	4.13 Probability Sampling Methods 4.14 Non-Probability Sampling Methods 4.15 Sample Design and Choice of Sampling Technique		
5	Data Collection, Processing and Analysis of Data 5.1 Collection of Primary Data 5.2 Method of data Collections - Observation, Interview, Questionnaires and Schedules 5.3 Difference between Questionnaires and Schedules 5.4 Some Other Methods of Data Collection 5.5 Collection of Secondary Data 5.6 Selection of Appropriate Method for Data Collection 5.7 Case Study Method 5.8 Processing Operations and Some Problems in Processing 5.9 Elements/Types of Data Analysis 5.10 Statistics in Research 5.11 Measures of Central Tendency, Dispersion, Asymmetry (Skewness) 5.12 Measures of Relationship - Chi-Square, t-test, ANNOVA(f-test), Z-test 5.13 Simple Regression Analysis, and Multiple Correlation and Regression 5.14 Partial Correlation and Association in Case of Attributes 5.15 Quantitative and Qualitative Data Analysis Tools	10	CO5
6	Interpretation and Report Writing 6.1 Meaning of Interpretation, Why Interpretation? 6.2 Technique of Interpretation 6.3 Precaution in Interpretation 6.4 Significance of Report Writing 6.5 Different Steps in Writing Report 6.6 Layout of the Research Report 6.7 Types of Reports (Research Proposal/Synopsis, Research Paper, and Thesis) 6.8 Oral Presentation 6.9 Mechanics of Writing a Research Report 6.10 Precautions for Writing Research Reports	8	CO6, CO7, CO8
7	Publication Ethics and Open Access Publishing 7.1 Publication ethics: definition, introduction and importance 7.2 Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. 7.3 Conflicts of interest 7.4 Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types 7.5 Violation of publication ethics, authorship and contributor ship 7.6 Identification of publication misconduct, complaints and appeals 7.7 Predatory publishers and journal 7.8 Open access publications and initiatives	8	CO7, CO9

	<p>7.9 SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies</p> <p>7.10 Software tool to identify predatory publications developed by SPPU</p> <p>7.11 Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.</p> <p>7.12 E-Resources for research: Google Scholar, Shodh Ganaga, Shodh Gangotri</p>		
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Reference Books:

1. Researching Information Systems and Computing by Briony J Oates, SAGE SOUTH ASIA Ed
2. Research Methodology: A Step-by-Step Guide for Beginners, Kumar, Pearson Education.
3. Research Methodology Methods and Techniques, Kothari, C. R., Wiley Eastern Ltd.
4. The Research Methods Knowledge Base, by William M. K. Trochim, James P. Donnelly
5. Introducing Research Methodology: A Beginner’s Guide to Doing a Research Project, UweFlick
6. A Guide to Research and Publication Ethics by Partha Pratim Ray, New Delhi Publishers
7. RESEARCH & PUBLICATION ETHICS by Wakil kumar Yadav, NOTION PRESS
8. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd.

Sem-II

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - II

Course code: IT-551-MJ
Course Title: Artificial Intelligence

No. of Credits: 04

Total Hours: 60

Course Outcome: On completion of the course, student will be able to understand,

1. Introduce AI and Ethical considerations.
2. Develop an intelligent game-playing agent using search algorithms.
3. Implement a knowledge-based reasoning system for decision-making.
4. Build and evaluate machine learning models for classification and regression tasks.
5. Create a deep learning model for image recognition using CNNs.
6. Construct an NLP model for sentiment analysis using word embeddings.
7. Develop a reinforcement learning agent capable of learning from interactions.
8. Apply ethical considerations and AI safety principles in AI development.
9. Identify problems where artificial intelligence techniques are applicable.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Introduction to AI 1.1 Definition and history of AI 1.2 Scope and applications of AI 1.3 Ethical considerations in AI development	4	CO1
2	Problem Solving and Search Algorithms 2.1 Problem-solving using search algorithms 2.2 Informed search: A* algorithm, heuristics 2.3 Game-playing agents: Minimax, Alpha-Beta Pruning	8	CO2
3	Knowledge Representation and Reasoning 3.1 Propositional and predicate logic 3.2 Resolution and inference in logic 3.3 Knowledge representation using graphs and frames	8	CO3
4	Machine Learning Fundamentals 4.1 Supervised learning and regression 4.2 Classification algorithms: SVM, Decision Trees, k-NN 4.3 Model evaluation and cross-validation	8	CO4
5	Neural Networks and Deep Learning 5.1 Introduction to neural networks and activation functions 5.2 Training neural networks: Backpropagation, optimization	9	CO5

	techniques 5.3 Convolutional Neural Networks (CNNs) for computer vision		
6	Natural Language Processing (NLP) 6.1 Text preprocessing and tokenization 6.2 Word embeddings: Word2Vec, GloVe 6.3 Sentiment analysis and text classification	7	CO6
7	Reinforcement Learning 7.1 Markov Decision Processes (MDPs) and dynamic programming 7.2 Q-learning and Temporal Difference (TD) learning 7.3 Deep Q Networks (DQNs) for Deep RL	7	CO7
8	AI Ethics and Future Trends 8.1 Ethical considerations in AI development and deployment 8.2 AI safety and bias mitigation 8.3 Emerging trends in AI research and applications	4	CO8
9	AI Project 9.1 Sample Project: Image Classification with Convolutional Neural Networks (CNN)	5	CO9

References Books:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
3. "Deep Learning" by Ian Goodfellow, YoshuaBengio, and Aaron Courville
4. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem-II

Course Code: IT-552-MJ
Course Title: Emerging Technology

No. of Credits:04

Total Hours: 60

Course Outcome: On completion of the course, student will be able to understand,

1. Identify different emerging technologies.
2. Differentiate different emerging technologies.
3. Select appropriate technology and tools for a given task.
4. Identify necessary inputs for the application of emerging technologies.
5. Study & Design various case studies using big data tools/commands and analyze it.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1.	Introduction to Emerging Technologies Evolution of Technologies, Role of data emerging technologies, enabling devices and networks for emerging technologies, human-to-machine interaction, futures trends in emerging technologies.	5	CO1
2.	Virtual Reality Introduction to Virtual Reality. Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality. Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based 3D Menus & 3D Scanner etc; Output -- Visual / Auditory / Haptic Devices	7	CO3
3.	Holography Technology What is Holography Technology, Features, Components, How Holography works? Benefits, Principles of Holography Technology, Applications in various fields.	8	CO3
4.	Big Data Introduction to Big Data, Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big	10	CO4, CO5

	Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics Life Cycle.		
5.	HADOOP Streaming & IN-Memory Computation with SPARK Objectives, Introduction, Hadoop Streaming, Advanced Map Reduce, Spark Basics, The Spark Stack Resilient Distributed Datasets (RDD), A typical Spark application	10	
6.	The Hadoop Ecosystem Introduction to Hadoop, Hadoop Architecture, History of Hadoop-Facebook, Dynamo, Yahoo, Google Hadoop Components :HDFS, Mapreduce, Introduction to Pig, Hive ,HBase, Mahout ;Installation of single node cluster-installation of java Hadoop configuration.	8	CO4
7.	Electronics for SMART Agriculture Introduction to IOT, IOT in Agriculture, Wireless sensor networks, IOT network using LoRaWAN. Open Agriculture Initiative (OpenAg), Agriculture & Electronics Governance: Technological Difficulties in Indian Context, Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.	8	CO4
8.	Introduction to Other emerging technologies Biotechnology, Quantum technology, Computer Vision, 3d printing, edible printing	4	CO2

Reference Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009. 2.
2. Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2005.
4. Shimon Y. Nof, "Springer Handbook of Automations", Springer.
5. Ernest O. Doebelin; " Measurement System Application and Design "; Mc-Graw Hill; 5th Edition.
6. Data Analytics with Hadoop - An Introduction for Data Scientists by Benjamin Bengfort and Jenny Kim.
7. Big Data Case Study by Bernard Marr –Willey Publications
8. Apache Spark https://www.tutorialspoint.com/apache_spark/index.html

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem – II

Course code: IT-553-MJ
Course Title: Advance Networking

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Understand the Internet Protocol, Routing Protocol.
2. Explore protocols at application layer.
3. Analyze the fundamentals concepts of computer security and network security.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Network Layer 1.1 Introduction to TCP/IP Protocol Suite 1.2 Logical addressing 1.3 IPv4 Addresses, Classful & Classless addresses 1.4 NAT 1.5 IPv6 Addressing 1.6 Network layer protocol - Internetworking, IPv4, IPv4 protocol packet format, IPv6 Protocol & Packet format, IPv4 VS IPv6, Transition from IPv4 to IPv6 1.7 Address Resolution protocols(ARP, RARP), BOOTP, DHCP 1.8 Routing Protocols - Delivery, forwarding, routing, types of routing, routing tables, Unicast Routing, Unicast Routing protocols, 1.9 RIP, Concepts of OSPF, BGP & Multicast Routing 15L	7	CO1
2	Domain Name System in Application Layer 2.1 Types of Name space-Flat name space, Hierarchical name space 2.2 Domain Name Space -Label, Domain name, FQDN,PQDN 2.3 Distribution of Domain Name Space-Hierarchy of name servers, zone, Root server, Primary and secondary servers. 2.4 DNS in internet : Generic domains, Country domains, inverse domain 2.5 Resolution-Resolver, mapping names to address, mapping addresses to names, recursive resolution, iterative resolution, caching	7	CO2

3	Electronic mail 3.1 Architecture-First scenario, second scenario, Third scenario, Fourth scenario 3.2 User agent-services of user agent, types of UA Format of email 3.3 MIME-MIME header 3.4 Message transfer agent-SMTP 3.5 Message Access Agent: POP and IMAP	5	CO2
4	File Transfer Protocol 4.1 FTP-Connection, Communication, Command Processing, Security for FTP, Anonymous FTP	3	CO2
5	Internet Security 5.1 IPSecurity(IPSec) 5.2 Services provided by IPSec 5.3 Security association 5.4 Internet key exchange 5.5 SSL/TLS 5.6 Transport layer security 5.7 PGP 5.8 Firewalls	8	CO3

References Books:

1. TCP / IP Protocol Suite Fourth Edition – Behrouz A. Forouzan
2. Computer Networks Fourth Edition – Andrew Tanenbaum
3. Cryptography & Network Security – William Stallings

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - II

Course code: IT-554-MJP
Course Title: Lab Course on Artificial Intelligence

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Develop an intelligent game-playing agent using search algorithms.
2. Build and evaluate machine learning models for classification and regression tasks.
3. Develop a reinforcement learning agent capable of learning from interactions.
4. Apply ethical considerations and AI safety principles in AI development.
5. Identify problems where artificial intelligence techniques are applicable.

Lab assignments using Python:

1. **Image Classification with Machine Learning:** Implement a machine learning model (e.g., SVM, k-NN) to classify images from the MNIST or CIFAR-10 dataset.
2. **Sentiment Analysis with Natural Language Processing:** Build an NLP model using libraries like NLTK or spaCy to analyze sentiment in text data.
3. **Face Recognition with Deep Learning:** Develop a face recognition system using pre-trained deep learning models like OpenCV or Dlib.
4. **Chatbot Implementation:** Create a simple chatbot using Python and natural language processing libraries to engage in conversation with users.
5. **Reinforcement Learning Agent for a Game:** Design a reinforcement learning agent using libraries like OpenAI Gym to learn and play a game.
6. **Stock Price Prediction with Time Series Analysis:** Use libraries like pandas and scikit-learn to predict stock prices based on historical data.
7. **Object Detection with Computer Vision:** Implement object detection using pre-trained models like YOLO or SSD with Python and OpenCV.
8. **Language Translation with Seq2Seq Models:** Train a sequence-to-sequence model using TensorFlow or PyTorch for language translation tasks.
9. **Anomaly Detection with Unsupervised Learning:** Detect anomalies in data using unsupervised learning algorithms like Isolation Forests or One-Class SVM.
10. **Emotion Recognition from Facial Expressions:** Create a Python program that can recognize emotions from facial expressions in images or videos.

These practical assignments provide a hands-on experience with AI using Python, and they cover a diverse range of AI topics and applications.

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem-II

Course Code: IT-555-MJP
Course Title: Lab Course on Emerging Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Differentiate different emerging technologies.
2. Identify necessary inputs for the application of emerging technologies.
3. Study & Design various case studies using big data tools/commands and analyze it.

Lab Assignments on Bigdata:

NOTE: It is expected to form teams and ask students to solve these case studies, discuss and work on solutions. (Refer Book No 7 for solving case studies. In detail explanation for case studies below is given in the said book)

1. Case study on Facebook.
2. Case Study on IoT Sensors.
3. Case Study on Banking.
4. Case study on Amazon.

Practical's Note:

Slips should be designed on the basis of following topics at college level.

The practical's should be taken on the basis of above case studies.

1. Navigating in Hadoop environment [Operational commands in Hadoop environment like moving, copying files. creating directories etc.
2. Understand HDFS (HDFS Commands)
3. Development in Hadoop environment , using various Hadoop tools/utilities
4. Develop mapReduce programs [Assignments] - Develop mapReduce functions either in Java or Python.

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - II

Course code: IT-560-MJ
Course Title: Angular JS

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Build web applications and native mobile apps using Angular.
2. Understand the fundamentals of Angular Forms and its architecture.
3. Present data in beautiful, interactive lists.
4. Build forms and setting pages.
5. Implement Single Page Application.(SPA)

Chapter No.	Course Contents	No. of Lectures	CO Targeted
1	Introduction to Angular JS 1.1 Introduction to AngularJS 1.2 MVC Architecture 1.3 Conceptual Overview 1.4 Setting up the Environment 1.5 First Application 1.6 Understanding ng attributes 1.7 Expressions and Data Biding 1.7.1 Number and String Expressions 1.7.2 Object Binding and Expressions 1.7.3 Working with Arrays 1.7.4 Forgiving Behavior 1.7.5 Understanding Data binding	6	CO2
2	Working with Directives and Controllers 2.1 Conditional Directives 2.2 Styles Directives 2.3 Mouse and Keyboard Events Directives 2.4 Understanding Controllers 2.5 Programming Controllers & \$scope object 2.6 Adding Behavior to a Scope Object 2.7 Passing Parameters to the Methods 2.8 Having Array as members in Controller Scope. 2.9 Nested Controllers and Scope Inheritance. 2.10 Multiple Controllers and their scopes	6	CO3
3	Filters and Forms 3.1 Built-In Filters 3.2 Uppercase and Lowercase Filters	6	CO4

	3.3 Currency and Number Formatting Filters 3.4 OrderBy Filter 3.5 Filter Filter 3.6 Creating Custom Filter 3.7 Using Simple Form 3.8 Working with Select and Options 3.9 Input Validations 3.10 Using CSS classes 3.11 Form Events 3.12 Custom Model update triggers 3.13 Custom Validations		
4	Modules, Services and Database Connectivity 4.1 Why Module? 4.2 Module Loading and Dependencies 4.3 Recommended Setup of Application 4.4 Creation vs Retrieval. 4.5 Understanding Services 4.6 Developing Creating Services 4.7 Using a Service 4.8 Injecting Dependencies in a Service 4.9 Connecting, Configuring databases 4.10 Updating Records 4.11 Working with Select Command 4.12 Deleting Records	8	CO1
5	Introduction to Ajax in AngularJS & Routing 5.1 \$http Service 5.2 \$q Service 5.3 Ajax Impl. using \$http and \$q Service 5.4 Introduction to SPA 5.5 Creating HTML Templates 5.6 Configuring Route Provider.	4	CO5, CO1

Reference Books:

1. Beginning Angular JS – by Andrew Grant Published by Apress Publication
2. Learning AngularJS – by Ken Williamson Published by O’Reilly Media
3. The ng-book: A Complete Book on Angularby Felipe Coury, Ari Lerner, Carlos Taborda Published by Fullstack.io gisia
4. Angular: Up and Running: Learning Angular, Step by Step - by Shyam Seshadri Published by O’Reilly
5. Angular: From Theory To Practice- by Asim Hussain Published by CodeCraft
6. Angular 6 for Enterprise-Ready Web Applications- by Doguhan Uluca Published by Packt Publishing
7. Angular in Action - by Jeremy Wilken Published by Manning Publications

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem - II

Course code: IT-561-MJP
Course Title: Lab Course on Angular JS

No. of Credits: 2

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Build web applications and native mobile apps using Angular.
2. Implement Single Page Application.(SPA)

Lab Assignments:

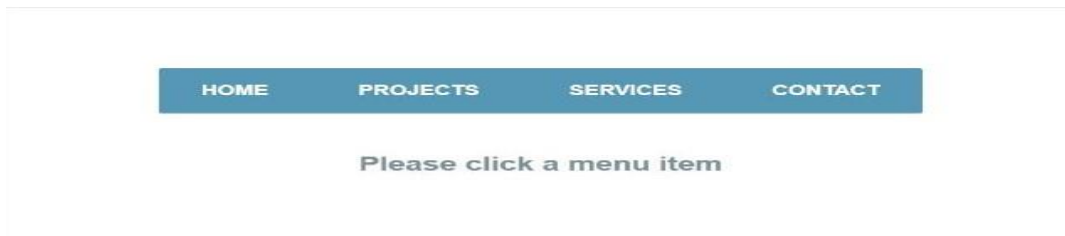
1. Practical Assignments based on basic Angular JS.
2. Practical Assignments based on Directives and Controllers.
3. Practical Assignments based on Filters and Forms.
4. Practical Assignments based on Modules, Services and Database Connectivity.
5. Practical Assignments based on Ajax in Angular JS and Routing.

Sample Practical Programs:

1. a) Write angular JS Program to bind product of 2 numbers.
b) Write angular JS Program to perform Arithmetic operation on two numbers.
c) Write an angular JS Program to count movement of the cursor on the screen.
2. Using AngularJS Create a SPA that show address and contact details of Some 5-10 top Hotels which are in pune location.(use ng-view)
3. Build a to-do list application where users can add, edit, and delete tasks.
4. Implement a basic calculator with functionalities for addition, subtraction, multiplication, and division.
5. Create a user registration and login system using AngularJS and store user data in the browser's local storage and validate all the fields.
6. Create an HTML form using Angular JS that contain the Employee Registration details and validate DOB, Joining Date, and Salary and also create a simple arithmetic calculator.
7. Using angular js create a SPA that to accept the details such as name, mobile number, pincode and email address and make validation. Name should contain character only, mobile number should contain only 10 digit, Pin code should contain only 6 digit, email id should contain only one @, . Symbol
8. Build an image gallery where users can upload and view images. Add features like filtering and sorting based on image tags.
9. Create a recipe book application where users can add, view, and search for recipes.
10. Create an HTML form using Angular JS that contain the Student Registration details and validate Student first and last name as it should not contain other than alphabets and age

should be between 18 to 50 and display greeting message depending on current time using ng-show (e.g. Good Morning, Good Afternoon, etc.)(Use AJAX).

11. Using angular js create a SPA to fetch suggestions when is user is typing in a textbox. (eg like google suggestions. Hint create array of suggestions and matching string will be displayed).
12. Using angular js create a SPA to carry out validation for a username entered in textbox. If the textbox is blank, alert 'Enter username'. If the number of characters is less than three, alert ' Username is too short'. If value entered is appropriate the print 'Valid username' and password should be minimum 8 characters.
- 13.



14. Using AngularJS Create a SPA that show History of some(4-8) Historical Places. (use MVC)
15. Create an HTML form Using AngularJS for Login system and validate email ID using Regular Expression and password should be minimum 8 characters.

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem-II

Course code: IT-562-MJ
Course Title: Digital Marketing

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. To gain fundamental knowledge of digital marketing.
2. To design and develop a website using word press technology.
3. Discuss the various MISC tools.
4. Explain the various concepts like online marketing, SEO, Social media marketing, mobile marketingetc.

Chapter No.	Course Contents	No. of Hours	CO Targeted
1	Introduction to Digital Marketing 1.1 What is Digital Marketing? 1.2 Why Digital Marketing 1.3 Types of Digital Marketing 1.4 Difference between traditional marketing and digital marketing 1.5 Importance of digital marketing 1.6 How to use digital marketing to increase sales? 1.7 How to conduct a competitive analysis?	8	CO1
2	Search Engine Optimization 2.1 What is a search engine? 2.2 Types of search engine 2.3 How does a search engine work? 2.4 Why is Google the world's best search engine? 2.5 Basics of SEO 2.6 On-Page SEO vs Off-Page SEO 2.7 What is the main purpose of using keywords in SEO? 2.8 Some important SEO tools	8	CO3
3	WordPress Website Creation 3.1 What is a website? 3.2 What is www? 3.3 What are the different types of websites? 3.4 Web page vs website 3.5 Difference between blog vs website	6	CO2

	3.6 What is WordPress? 3.7 Understanding WordPress and its functioning? 3.8 Features of WordPress 3.9 Sites built with WordPress		
4	Mobile and Social Media Marketing 4.1 What is Mobile Marketing? 4.2 Methods of Mobile Marketing 4.3 How to create a mobile website/App? 4.4 Why Focus on Smartphone Apps? 4.5 Advertising on Mobile App 4.6 Importance and Future Scope 4.7 Facebook Marketing 4.8 Instagram Marketing 4.9 YouTube Marketing	8	CO4

References Books:

1. Digital Marketing by Vandana Ahuja; Oxford University Press.
2. Internet Marketing and e-Commerce; by Ward Hanson Cengage.
3. Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World; by Chuck Hemann Ken Burbary Que Publishing.
4. The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson Wiley publication.

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem-II

Course code: IT-563-MJP
Course Title: Lab Course on Digital Marketing

No. of Credits: 2

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. To design and develop a website using word press technology.
2. To explain the various concepts like online marketing, SEO, Social media marketing, mobile marketing etc.

Lab Assignments:

1. Practical on Installation on WordPress.
2. Create an Advertisement in WordPress.
3. Create Website in WordPress.
4. Create Advertisement and post on Facebook.
5. Create Advertisement and post on Instagram.
6. Create Advertisement in YouTube.

Savitribai Phule Pune University
M.Sc.(Information Technology)
Sem – II

Course Code: IT-564-MJ
Course Name: Blockchain Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Provide an overview of the concept and technology of Blockchain and major components of blockchain.
2. Aware students with working of Blockchain.
3. Aware students with concept and working of Bitcoin.
4. Provide a knowledge to students about Ethereum & Smart Contracts.
5. Aware students with limitations and challenges of blockchain and applicability of blockchain in different areas using case study.

Chapter No.	Course Contents	No. of Lectures	CO Targeted
1	Introduction 1.1 Introduction of Blockchain 1.2 Blockchain Vs Database 1.3 Need of Blockchain 1.4 History of Blockchain 1.5 Blockchain version – Currency, Smart Contracts, Dapps 1.6 Blockchain Transactions 1.7 Blockchain components 1.8 Blockchain- Hashing 1.9 Blockchain- public key cryptography 1.10 Cryptography (private and public keys, Hashing & Digital Signature) 1.11 Blockchain Consensus Mining 1.12 Consensus Mechanisms 1.13 Cryptocurrency, Digital Currency Bitcoin and Ethereum 1.14 Smart Contracts 1.15 Blockchain use cases	4	CO1
2	Working of Blockchain 2.1 Understanding SHA256 Hash 2.2 Immutable Ledger 2.3 Distributed P2P Network 2.4 How Mining Works? (The NONCE and Cryptographic Puzzle) 2.5 Byzantine Model of Fault Tolerance 2.6 Consensus Protocols: Proof of Work, Proof of State, Défense	7	CO2

	<p>Against Attackers, Competing Chains</p> <ul style="list-style-type: none"> - Byzantine Generals problem - Objectives of Consensus protocol - Consensus algorithms - Other consensus mechanisms <p>2.7 Blockchain Demo</p>		
3	<p>Basics of Bitcoin</p> <p>3.1 Introduction to Bitcoin</p> <p>3.2 Working of bitcoin</p> <p>3.3 Challenges and solutions</p> <p>3.4 Proof of work, Proof of stake,</p> <p>3.5 Alternatives to Bitcoin consensus</p> <p>3.6 Bitcoin scripting language and their use</p> <p>3.7 Bitcoin Mining</p> <p>3.8 Role of Bitcoin Miner</p> <p>3.9 Bitcoin chaining blocks</p>	6	CO3
4	<p>Ethereum & Smart Contracts</p> <p>4.1 What Is Ethereum & How Does It Differ To Bitcoin?</p> <p>4.2 Features of Ethereum</p> <p>4.3 Type of Ethereum Accounts</p> <p>4.4 How Does Ethereum Work</p> <p>4.5 Real-World Applications of Ethereum</p> <p>4.6 Benefits & Drawbacks of Ethereum</p> <p>4.7 Ether, Smart Contract, Ethereum Virtual Machine (EVM)</p> <p>4.8 Ethereum Virtual Machine (EVM), Ether, Gas</p> <p>4.9 Working of EVM</p> <p>4.10 What is Ethereum Mining?</p> <p>4.11 What is a Smart Contract?</p> <p>4.12 Ethereum and Smart Contracts</p> <p>4.13 Demo of remix - Ethereum IDE</p> <p>4.14 Decentralized Applications (Dapps)</p> <p>4.15 Decentralized Autonomous Organizations (DAO)</p> <p>4.16 Hard and Soft Forks</p> <p>4.17 Initial Coin Offerings</p> <p>4.18 Demo of Smart Contracts (using solidity)</p> <p>4.19 Bitcoin vs Ethereum</p> <p>4.20 Applications of Ethereum</p>	7	CO4
5	<p>Limitations and challenges of blockchain & Case Studies</p> <p>5.1 Blockchain implementation – limitations</p> <ul style="list-style-type: none"> - Limited scalability - Limited Privacy - Lack of technical knowledge - Security concerns and flaws <p>5.2 Blockchain implementation – Challenges</p> <ul style="list-style-type: none"> - Transaction processing speed 	6	CO5

	<p>5.3 Case study</p> <ul style="list-style-type: none"> - Blockchain in Banking and finance - Blockchain in education - Blockchain in energy - Blockchain in Supply Chain Management - Blockchain in healthcare - Blockchain in government services - Blockchain in real-estate 		
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Reference Books:

1. Blockchain for Beginners by Yathis R. , Tejaaswini N., SPD Publication
2. Blockchain Applications: A Hands-On Approach by Arshdeep Bahga , Vijay Madiseti
3. Blockchain Technology by S. Chandramouli, Asha George, Abhilash K., Meena Karthikeyam, University Press Publication
4. Blockchain for dummies by Tiana Laurence (Author), A Wiley board Publication
5. Beginning Blockchain : A Beginner’s Guide to Building Blockchain Solutions by Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media
6. The Fundamentals of Blockchain Technology by Saurabh Jain
7. Mastering Blockchain by Imran Bashir, Third Edition, Packet Publication
8. Mastering Ethereum: Building Smart Contracts and DAPPS by Andreas Antonopoulos, Dr. Gavin Wood, Oreilly Publication

Savitribai Phule Pune University

M.Sc.(Information Technology)

Sem – II

Course Code: IT-565-MJP

Course Name: Lab Course on Blockchain Technology

No. of Credits: 02

Total Hours: 30

Course Outcome: On completion of the course, student will be able to understand,

1. Provide knowledge to students about Ethereum & Smart Contracts.
2. Aware students with limitations and challenges of blockchain and applicability of blockchain in different areas using case study.

Lab Assignments:

1. Installation of Ganache, Flask and Postman
2. Write a Simple Python program to create a Block class that contains index, timestamp, and previous hash. Connect the blocks to create a Blockchain.
3. Demo of Remix-Ethereum IDE <https://remix.ethereum.org> and Test Networks
4. Write a Simple Smart Contract for Bank with withdraw and deposit functionality using solidity.
5. Write a Smart Contract for storing and retrieving information of Degree Certificates using solidity.

Savitribai Phule Pune University
M.Sc. (Information Technology)
Sem – II
Course Code: IT-581-OJT

Course Name: On Job Training (Internship)

No. of Credits: 04

Total Hours: 120

Course Outcome: On completion of the course, student will be able to understand,

1. To provide students with practical, hands-on-experience in applying theoretical knowledge to real-world tasks.
2. To help students develop and enhance their skills, problem solving abilities and work culture of the industry.
3. To foster effective teamwork and collaboration skills.
4. To encourage students to build and expand their professional network by interactive with experienced experts and mentors in industry.

Guidelines for On Job Training (IT-581-OJT):

- Students must start the OJT/Internship immediately after Semester-II examination during the summer vacation.
- Students are expected to complete the IT related work/Project within 120 hours assigned by Company/Industry/Consultancy/Institution.
- College should assign the mentor for group of 10 students to monitor the progress throughout the OJT.
- Students have to submit the weekly progress report duly signed by the concern authorities of company to the mentor.
- At the end of OJT, students should prepare documentation and submit a report.
- The final presentation and documentation will be evaluated by the Examination panel.