



**Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Ganeshkhind, Pune 411016**

Two Year Degree Program in Computer Science

NATIONAL EDUCATION POLICY (NEP-2020)

(Faculty of Science & Technology)

Syllabi for M.Sc. (Computer Science) Part- I & II

Choice Based Credit System Syllabus

To be implemented from Academic Year

Part I 2023-2024

Part II 2024-2025

Title of the Course: M.Sc. (Computer Science)

Preamble: This syllabus is a credit-based system to be implemented from the academic year 2023-2024. It is believed that the proposed changes as part of the credit-based system will bring a qualitative change in the way M.Sc. (Computer Science) is taught, which will offer a more enriched learning experience. It aims to provide technology-oriented students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer systems and technology on people and society. The syllabus is about developing skills to learn new technology, grasping the concepts and issues behind its use and the use of computers.

Duration: 2 years**Eligibility:**

- Bachelor of Computer science BSc(Computer Science) with 50% marks for Unreserved category and 45% marks for Reserved Category
- Bachelor of Engineering in Computer Science/ Information Technology/Electronics/ Telecommunication with 50% marks
- BSc. In IT or BSC in entire Computer science with 50% marks
- B. Voc in software Development/Information Technology with 50% marks
- BSc. Degree with Computer Science as Principal subject or Computer Science as one of the subjects at T.Y.BSc. Level for student with general BSC with 50%

Year I Semester -I M.Sc.(Computer Science)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCS51101	Paradigm of Programming Languages	4	-	40	60	100
Mandatory COMCS51102	Database Technologies	4	-	40	60	100
Mandatory COMCS51103	Artificial Intelligence	4	-	40	60	100
Mandatory COMCS51104	Practical on PPL & Databases Technologies	-	2	20	30	50
Elective COMCS51201	Cloud Computing	2	-	20	30	50
Elective COMCS51202	Cloud Computing Practical	-	2	20	30	50
RP COMCS51301	Research Methodology	2	-	20	30	50
RP COMCS51302	Practical on Research Methodology	-	2	20	30	50
Total		16	6	220	330	550
Year I Semester -II M.Sc.(Computer Science)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCS52101	Software Testing Using Manual and Automated Tools	4	-	40	60	100
Mandatory COMCS52102	Mobile Technologies	4	-	40	60	100
Mandatory COMCS52103	Emerging Trends in Data Science	4	-	40	60	100
Mandatory COMCS52104	Data Science Practical	-	2	20	30	50
Elective COMCS52201	Machine Learning	2	-	20	30	50
Elective COMCS52202	Machine Learning Practical	-	2	20	30	50

OJT COMCS52401	On Job Training/Field Project	-	4	40	60	100
Total		14	8	220	330	550
Year II Semester -III M.Sc.(Computer Science)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCS63101	Software Architecture & Design Patterns	4	-	40	60	100
Mandatory COMCS63102	Principles of Product Management	4	-	40	60	100
Mandatory COMCS63103	Cryptography and Test Cases	4	-	40	60	100
Mandatory COMCS63104	SADP & Practical using JAVA	-	2	20	30	50
Elective COMCS63201	Project	2	-	20	30	50
Elective COMCS63202	Project Related Assignments	-	2	20	30	50
RP COMCS63501	Research Project	-	4	40	60	100
Total		14	8	220	330	550
Year II Semester -IV M.Sc.(Computer Science)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCS64101	Business Intelligence	4	-	40	60	100
Mandatory COMCS64102	DevOps	4	-	40	60	100
Mandatory COMCS64103	DevOps Practical	-	4	40	60	100
Elective COMCS64202	Web Frameworks	2	-	20	30	50
Elective COMCS64501	Web Frameworks Practical	-	2	20	30	50

RP COMCS64501	Industrial Project/Industrial Training	-	6	60	90	150
Total		10	12	220	330	550

Total Credits: [54(TH) + 34 (PR)] =88

TH: Theory **PR:** Practical

CIE: Continuous Internal Evaluation **ESE:** External Semester Examination

Note : Any version of Linux (Fedora/ Redhat/ Ubuntu etc.) can be used as per your comfort

Detailed Syllabus:

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- I Semester- I		
Course Code: COMCS51101	Course Name: Paradigm of Programming Language	Total Lectures:60 Hours
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> ● Procedural Language like C ● Object-Oriented Languages (C++ and Java) ● Concepts of Operating Systems ● Basic Data Structures and Algorithms. 	
Course Objectives:	<ul style="list-style-type: none"> ● To Prepare student to think about programming languages analytically <ul style="list-style-type: none"> ○ Separate syntax from semantics ○ Compare programming language designs ○ Understand their strengths and weaknesses ○ Learn new languages more quickly ● Understand basic language implementation techniques ● Learn small programs in different programming Languages 	
Course Outcomes:	<p>After successfully completing this course, students will be able to:</p> <ul style="list-style-type: none"> ● learn syntax from semantics of different programming languages, compare them and will be able to find the pitfalls of them and think about programming languages analytically. ● will understand basic language implementation techniques and learn small programs in different programming languages. 	
Chapter	Course Contents	No. of Lectures
1	Introduction <ul style="list-style-type: none"> ● The Art of Language Design ● The Programming Language Spectrum ● Why Study Programming Languages? ● Compilation and Interpretation ● Programming Environments 	4
2	Names, Scopes, and Bindings <ul style="list-style-type: none"> ● Introduction ● Names ● Variables 	5

	<ul style="list-style-type: none"> ● Concept of Binding ● Scope ● Scope and Lifetime ● Referencing Environment ● Named Constant 	
3	<p>Control Flow</p> <ul style="list-style-type: none"> ● Expression Evaluation , Precedence and Associativity, Assignments, Initialization, Ordering Within Expressions, Short-Circuit Evaluation ● Structured and Unstructured Flow ● Sequencing ● Selection - Short-Circuited Conditions, Case/Switch Statements Iteration ● Iteration - Enumeration-Controlled Loops, Combination Loops, Iterators, Logically Controlled Loops Recursion ● Recursion - Iteration and Recursion, Applicative- and Normal-Order Evaluation 	7
4	<p>Data Types</p> <ul style="list-style-type: none"> ● Introduction ● Primitive Data Types ● Numeric Types: Integer, Floating point, Complex , Decimal, Boolean Types, Character Types ● Character String Types • Design Issues, Strings and Their Operations, String Length Operations, Evaluation, Implementation of Character String Types ● User defined Ordinal types of Enumeration types, Designs Evaluation Subrange types, Ada's design Evaluation Implementation of user defined ordinal types ● Array types ● Arrays and indices, Subscript bindings and array categories, Heterogeneous arrays, Array initialization, Array operations, Rectangular and Jagged arrays, Slices, Evaluation, Implementation of Array Types ● Associative Arrays ● Structure and operations, Implementing associative arrays, ● Union Types ● Pointer and Reference Types ● Pointer operations, Pointer problems, Dangling pointers, Lost heap dynamic variables, Pointers in C and C++, Reference types, Evaluation ● Implementation of pointer and reference types - Representation of pointers and references Solution to dangling pointer problem Heap management 	6
5	<p>Subprograms and Implementing Subprograms</p> <ul style="list-style-type: none"> ● Introduction ● Fundamentals of Subprograms ● Design Issues for subprograms ● Local Referencing Environments ● Parameter-Passing Methods 	8

	<ul style="list-style-type: none"> ● Parameters That Are Subprograms & Overloaded Subprograms ● Generic Subroutines, Generic Functions in C++, Generic Methods in Java ● Design Issues for Functions ● User-Defined Overloaded Operators ● Coroutines ● Implementing Subprograms ● Implementing “Simple” Subprograms ● Nested Subprograms ● Blocks ● Implementing Dynamic Scoping 	
6	Data Abstraction and Object Orientation <ul style="list-style-type: none"> ● Object-Oriented Programming ● Encapsulation and Inheritance Modules, Classes, Nesting (Inner Classes), Type Extensions, Extending without Inheritance ● Initialization and Finalization Choosing a Constructor, References and Values, Execution Order, Garbage Collection ● Dynamic Method Binding ● Virtual- and Non-Virtual Methods, Abstract Classes, Member Lookup, Polymorphism, Object Closures ● Types of Inheritance 	10
7	Concurrency <ul style="list-style-type: none"> ● Introduction : Multiprocessor Architecture Categories of concurrency, Motivations for studying concurrency ● Semaphores - Introduction Cooperation synchronization, Competition Synchronization, Evaluation ● Message Passing Introduction- The concept of Synchronous Message Passing 	8
8	Functional Programming in Scala <ul style="list-style-type: none"> ● Strings ● Numbers ● Control Structures ● Classes and Properties ● Methods ● Objects ● Functional Programming ● List, Array, Map, Set 	12

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Programming Language Pragmatics, 3edition	Michel L. Scott	Kaufmann Publishers, An Imprint of Elsevier, USA
2	Concepts of Programming Languages, Eighth Edition	Robert W. Sebesta	Pearson Education
3	Scala Cookbook	Alvin Alexander	O'REILLY publication

[Scala & Functional Programming Essentials | Rock the JVM | Udemy](#)
[Scala Programming In-Depth | Udemy](#)

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51102	Course Name: Database Technologies	Total Lectures: 60 Hours
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Knowledge of file system concepts ● Strong foundation of Related database Concepts (Basic & Advanced) ● A firm foundation of any RDBMS package 	
Course Objectives:	<ul style="list-style-type: none"> ● Provide an overview of the concept of NoSQL technology. ● Make the student capable of making choice of what database technologies to use on their application needs ● Provide an insight to the different types of NoSQL databases 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Differentiate between RDBMS and NOSQL technologies ● Understand various NOSQL technologies, their need, and applications ● Learn new concepts of data modelling, clustering, polyglot persistence, version stamps, map reduce, schema migrations ● Make choice of database technologies based on their needs and applications 	
Chapter	Course Contents	No. of Lectures
1	Database Systems Review Transaction, ACID Properties, Database recovery techniques, DB Failure	5
2	Introduction to NOSQL (Core concepts)	19
	Why NoSQL	
	Aggregate Data Models	
	Data modeling details	
	Distribution Models	
Consistency		

	Version stamps	
	Map-Reduce	
3	Implementation with NOSQL databases	20
	Document Databases (Mongodb)	
	Graph databases (Neo4j)	
4	Schema Migrations	5
5	Polyglot Persistence (Multi model types)	7
6	Choosing your database	4

References:

Sr. No.	Title of the Book	Author/s	Publication
1	NoSQL Distilled	Pramod Sadalge, Martin Fowler	Pearson
2	NoSQL for Dummies	A Willy Brand	Pearson
3	Multidisciplinary Subjects for Research-XV (implementation of NOSQL document databases – MONGODB)	Dipali Meher, Pallawi Bulakh, Meenal Jabde	Redshine
4	https://www.udemy.com/topic/nosql/		
5	https://www.udemy.com/topic/neo4j/		

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51103	Course Name: Artificial Intelligence	Total Lectures: 60 Hours
Teaching Scheme : 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits : 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Concepts of Data structures and Design and Analysis of algorithms. ● Strong data analytics skills. ● Strong will to learn machine learning languages. 	
Course Objectives:	<ul style="list-style-type: none"> ● To learn various types of algorithms useful in Artificial Intelligence (AI). ● To convey the ideas in AI research and programming language related to emerging technology. ● To understand the numerous applications and huge possibilities in the field of AI that goes beyond the normal human imagination. 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Learn the applications of A* and AO* algorithms. ● Learn different knowledge representation techniques. ● Learn machine learning basics using Python 	
Chapter	Course Contents	No. of Lectures
1	Introduction to Artificial Intelligence: <ul style="list-style-type: none"> ● Introduction and Intelligent systems ● What Is AI, The Foundations of Artificial Intelligence, ● The History of Artificial Intelligence ● Applications of AI ● Early work in AI and related fields ● AI problems and Techniques. 	5

2	<p>Searching:</p> <ul style="list-style-type: none"> Defining AI problems as a State Space Search: example, Search and Control Strategies, Problem Characteristics, Issues in Design of Search Programs, Production System. Blind Search Techniques :-BFS, DFS, DLS, Iterative Deepening, Search, Bidirectional Search, Uniform cost Search. Heuristic search techniques: Generate and test ,Hill Climbing, Best First search, Constraint Satisfaction, Mean-End Analysis, A*,AO*. 	20
3	<p>Knowledge Representation:</p> <ul style="list-style-type: none"> Representations and Mappings Approaches to Knowledge representation, Knowledge Representation method Propositional Logic, Predicate logic Representing Simple facts in Logic Resolution, Forward and backward chaining Game Playing- Minimax Search Procedures Adding alpha-beta cutoffs. 	20
4	<p>Introduction to AI with Python:</p> <ul style="list-style-type: none"> Introduction to Python why python with AI Features of Python, Basics of Python Python statements Methods & Functions using python Basic and advanced modules & Packages Python Decorators and generators Advanced Objects & Data structures. 	15
5	<p>Machine Learning:</p> <ul style="list-style-type: none"> Why Machine learning Types of Machine Learning Supervised learning- Classification & Regression. Random Forest, KNN Algorithm. Unsupervised learning-Clustering & Association. Reinforcement learning. 	10

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Computational Intelligence	Eberhart	Elsevier Publication
2	Artificial Intelligence: A New Synthesis	Nilsson	Elsevier Publication
3	Artificial Intelligence with Python	PrateekJoshi	Packt Publishing Ltd
4	Reinforcement and Systematic Machine Learning for Decision Making,	Parag Kulkarni	Wiley-IEEE Press Edition
5	Artificial Intelligence	Saroj Kausik	Cengage Learning
6	Introduction to Machine Learning	EthemAlpaydin	PHI 2nd Edition
7	Artificial Intelligence	Meenal Jabde, Charushila Patil	Nirali Publication

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51104	Course Name: PPL and Database Technologies Practical	Total Practical's: 10 +10=20
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Knowledge of file system concepts ● Knowledge of C and CPP programming concepts ● Strong foundation of Relational database Concepts (Basic & Advanced) 	
Course Objectives:	<ul style="list-style-type: none"> ● To Provide an overview of the concept of NoSQL technology. ● To Make the student capable of making choice of what database technologies to use on their application needs ● To Provide an insight to the MongoDB (Document database) and Neo4j(Graph Database) 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> ● Provide an insight to the different types of NoSQL databases used to real life applications. 	

	<ul style="list-style-type: none"> • Understand control structures, arrays, lists, maps, sets and static and dynamic memory allocation concepts and their implementation. • Create and handle databases and queries using various NQSQL technologies like MongoDB and Neo4j. • Handle graphical queries using Neo4j 	
PPL Practical		Number of Sessions
	<p>Control Structures</p> <ol style="list-style-type: none"> 1. Write a program to calculate the average of the first 50 odd numbers. 2. Write a program to get five random numbers and check that random numbers are prime or not. <p>Arrays</p> <p>Write a program to find maximum and minimum of an array</p> <p>Write a program to calculate transpose of a matrix and calculate determinant of a matrix</p> <p>Write a program to check if the matrix is upper triangular or not.</p> <p>String</p> <p>Write a program to count uppercase letters in a string and convert it to lowercase and display the new string.</p> <p>Write a program to read a character from the user and count the number of occurrences of that character.</p> <p>Display all the elements of an array containing a given string.</p> <p>Classes and Objects</p> <p>Define a class CurrentAccount (accNo, name, balance, minBalance). Define appropriate constructors and operations withdraw(), deposit(), viewBalance(). Create an object and perform operations. Create abstract class Shape with abstract functions volume() and display(). Extend two classes Cube and Cylinder from it. Calculate volume of each and display it.</p> <ol style="list-style-type: none"> 3. Create class Project (id, name, location). Define parameterized constructor. Keep a count of each object created and display the details of each project. <p>List</p> <p>Create Lists using five different methods(Lisp style , Java style, fill, range and tabulate methods)</p> <p>Create two Lists and Merge it and store the sorted in ascending order.</p>	<p>1</p> <p>2</p> <p>2</p> <p>2</p> <p>1</p>

	<p>Create a list of even numbers up to 10 and calculate its product. Write a program to create a list of 1 to 50 numbers.</p> <p>Map & Set</p> <ol style="list-style-type: none"> 1. Write a user defined function to convert lowercase letters to uppercase and call the function using Map. 2. Write a program to create maps with Rollno and FirstName. Print all student information with the same FirstName. 3. Write a program to create two sets and find common elements between them and merge two sets. 	2
Database technologies Practical		
Sr.No.	MongoDB Practical	Number of Sessions
1	<p>Database Practicals - Data Query Language(DQL) Statements Data Query Language(DQL) Statements: (Select statement with operations like Where clause, Order by, Logical operators, Scalar functions and Aggregate functions) Using Virtual Lab IIT Bombay http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/index.php</p>	1
2	<p>Assignment 1: Movie Database</p> <ol style="list-style-type: none"> 1. Create a database with the name 'Movie'. 2. A 'Film' is a collection of documents with the following fields: <ol style="list-style-type: none"> a. Film Id b. Title of the film c. Year of release d. Genre / Category (like adventure, action, sci-fi, romantic etc.) A film can belong to more than one genre. e. Actors (First name and Last name) A film can have more than one actor. A film can have more than one director. f. Release details (It consists of places of release, dates of release and rating of the film.) 3. An 'Actor' is a collection of documents with the following fields: <ol style="list-style-type: none"> a. Actor Id 	2

	<ul style="list-style-type: none"> b. First name c. Last Name d. Address (Street, City, State, Country, Pin-code) e. Contact Details (Email Id and Phone No) f. Age of an actor. <p>Queries:</p> <ol style="list-style-type: none"> 1. Insert at least 10 documents in the collection Film <ul style="list-style-type: none"> a. Insert at least one document with film belonging to two genres. b. Insert at least one document with film that is released at more than one place and on two different dates. c. Insert at least three documents with the films released in the same year. d. Insert at least two documents with the films directed by one director. e. Insert at least two documents with films those are acted by a pair ‘Madhuri Dixit’ and ‘Shahrukh Khan’. 2. Insert at least 10 documents in the collection Actor. <p>Make sure, you are inserting the names of actors who have acted in films, given in the ‘Film’ collection.</p> 3. Display all the documents inserted in both the collectAdd a value to the rating of the film whose title starts with ‘T’. 4. Add an actor named " _ " in the ‘Actor’ collection. Also add the details of the film in ‘Film’ collection in which this actor has acted in. 5. Delete the film " _____". 6. Delete all actors from an ‘Actor’ collection who have age greater than >60 7. Update the actor’s address where Actor Id is" _ " 	
<p>3</p>	<p>Assignment 2: Model the following Book system as document database Consider Set of books and publishers. Publisher can publish more than one book Book(Book name, Cost, Author, Published Year, Number of Pages) Publisher(name, language, books, city) Queries:</p> <ol style="list-style-type: none"> a. List all the publishers located in mumbai b. List all the book having pages> 500 c. List all the books having cost 500 	<p>3</p>

	<p>d. List all the books published in year 2020 e. List all the books written by “__” and published in 2020 f. List the books published in english language g. List the book published in marathi language</p> <p>Assignment 3: Model the following hospital database as document database Consider the hospitals in and around pune.Each hospital may have one or more specializations like pediatric, gynac, ortho.A person can recommend or provide review for a hospital. One doctor can be associated with more than one hospital. Queries: a. List the names of the hospitals with __ specialization b. List the names of doctors visiting to birla hospital on monday c. List the multispeciality hospitals d. List the names of hospitals having rating >=4 e. List the doctors who are specialized in ortho f. List the persons who have given ratings to sahyadri hospital</p>	
Neo4j Practical		Number of Sessions
	<p>Assignment 3: Song Database Consider a Song database, with labels as Artists, Song, Recording_company, Recoding_studio, song author etc. Relationships can be as follows Artist → [Performs] → Song → [Written by] → Song_author. Song → [Recorded in] → Recording Studio → [managed by] → recordingCompany Recording Company → [Finances] → Song You may add more labels and relationship and their properties, as per assumptions.</p> <p>a) List the names of songs written by “:.....” b) List the names of the songs recorded in”...” c) List the names of record companies who have financed for the song “....” d) List the names of artist performing the song “.....” e) Name the songs recorded by the studio “” f) List the names of artists who have sung only songs written by “ ” g) List the names of artists who have sung the maximum number of songs recorded by “.....” studio</p>	2
	<p>Assignment 4: Employee database Consider an employee database, with a minimal set of labels as follows Employee: denotes a person as an employee of the organization Department: denotes the different departments, in</p>	2

	<p>which employees work. Skillset: A list of skills acquired by an employee</p> <p>Projects: A list of projects in which an employee works. A minimal set of relationships can be as follows:</p> <p>Works_in :employee works in a department</p> <p>Has_acquired: employee has acquired a skill</p> <p>Assigned_to : employee assigned to a project</p> <p>Controlled_by: A project is controlled by a department</p> <p>Project_manager : Employee is a project_manager of a Project</p> <ol style="list-style-type: none"> List the names of employees in department “...” List the projects along with their properties, controlled by department “.....”. List the departments along with the count of employees in it. List the skillset for an employee “ ” List the projects controlled by a department “...” List the names of the projects belonging to departments managed by employee “ ...“ 	
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Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51201	Course Name: Cloud Computing	Total Lectures: 30 Hours
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Operating System concepts ● Fundamentals of Computer Networks ● Good Understanding of Object-Oriented Programming Concepts 	
Course Objectives:	<ul style="list-style-type: none"> ● To understand the principles and paradigm of Cloud Computing ● To appreciate the role of Virtualization Technologies ● Ability to design and deploy Cloud Infrastructure ● Understand cloud security issues and solutions 	
Course Outcomes:	<p>At the end of the course, the student should be able to:</p> <ul style="list-style-type: none"> ● Appreciate the need for cloud computing and make decisions on using specific cloud service type and deployment models ● Identify virtualization technologies of a cloud platform. ● Make choices on selection of appropriate cloud service based on application requirements. 	
Chapter	Course Contents	No. of Lectures
1	Introduction to Cloud Computing <ul style="list-style-type: none"> ● Overview, Layers and Types of Cloud ● Desired Features of a Cloud ● Benefits and Disadvantages of Cloud Computing ● Cloud Infrastructure Management, <ul style="list-style-type: none"> ◦ 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. ◦ Infrastructure as a Service, Platform as a Service, Software as a Service, Cloud Deployment Models. ◦ Cloud economics and benefits, 	8

2	Abstraction and Virtualization <ul style="list-style-type: none"> ● Introduction to Virtualization Technologies ● Load Balancing and Virtualization ● Understanding Hyper visors, ● Virtual Machines -Provisioning and Manageability Virtual Machine ● Provisioning in the Cloud Context ● Virtualization of CPU, Memory, I/O Devices ● Virtual Clusters and Resource management 	7
3	Programming, Environments and Applications <ul style="list-style-type: none"> ● 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 	8
4	Security In The Cloud Security Overview <ul style="list-style-type: none"> ● 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 	7

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center	Brian J.S. Chee and Curtis Franklin	CRC Press, ISBN :9781439806128
2	Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi	Mastering Cloud Computing: Foundations and Applications Programming	McGraw Hill, ISBN: 978 1259029950, 1259029956
3	Kai Hwang, Geoffrey C Fox, Jack G Dongarra	Distributed and Cloud Computing, From Parallel Processing to the Internet of Things	Morgan Kaufmann Publishers, 2012.
4	Cloud Computing	Dr. Satish Ambike, Dr. Rajesh K Dhumal	Nirali Publication ISBN: 9789354512520

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51202	Course Name: Cloud Computing Practical	Total Practical's: 10
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Basic knowledge of distributed computing system ● Knowledge of virtualization concept 	
Course Objectives:	<ul style="list-style-type: none"> ● To Obtain knowledge of cloud computing fundamentals and benefits of cloud computing ● To Understand the various virtualization technologies in detail ● To Understand data center and cloud storage concept 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Understand core issues in cloud computing such as security, privacy, and interoperability. ● provide the appropriate cloud computing solutions and recommendations according to the applications used. ● identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc. ● identify problems, and explain, analyze, and evaluate various cloud computing solutions. 	
Assignment Number	Assignment Name	Number of Sessions
1	Working and Implementation of Infrastructure as a service 1. Launching EC2 Instance(windows)- AWS Platform Prepare Screenshots file 2. Write down the steps to launch EC2 instance(windows)	1
2	Working and Implementation of Infrastructure as a service Launching EC2 Instance(Linux)- AWS Platform .Prepare Screenshots file Write down the steps to launch EC2 instance(Linux)	1
3	Working and Implementation of Infrastructure as a service Create an EC2 Linux Instance and Install an Apache Web Server and run hello World page (Use AWS Platform) Prepare Screen shots file and also write down the steps and commands used.	1
4	Practical Implementation of Storage as a Service	1

	Create an S3 Bucket, Upload a file to S3 Bucket, Retrieve a File from S3 Bucket, and Delete a File from S3 Bucket using AWS.	
5	Implementation of Storage as a Service Hosting a static website in AWS using S3.	1
6	Working and Implementation of identity management.	1
7	Write a program for web feed. Using EC2 Service install Red-hat Linux instance and install python and run python program	1
8	Working and Implementation of Platform as a services . AWS Elastic Beanstalk: Use this tool to upload sample code for web apps. (AWS handles the deployment, provisioning and load balancing)	1
9	Virtual Private Cloud	1
10	Launch RDS Instance (AWS).	1

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51301	Course Name: Research Methodology	No. of Lectures : 30
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Basic knowledge of computer science subject ● Reading and analytical skills 	
Course Objectives:	<ul style="list-style-type: none"> ● To enable students to undertake independent research of a business problem, and to analyze and present their findings. ● To familiarize students with the basic techniques of collection, analysis, interpretation and presentation of data. ● To formulate a research proposal for a business project. ● To obtain knowledge of research methodology 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Understand research terminology ● Be aware of the ethical principles of research, ethical challenges and approval processes ● Describe quantitative, qualitative and mixed methods approaches to research ● Identify the components of a literature review process ● Critically analyze published research 	
Chapter	Course Contents	Number of Lectures
1	Introduction to Research: Definition, meaning, characteristics of Research	2
2	Types of Research, Introduction Nature of qualitative and quantitative research, Research in functional areas of management, Process of Research, Formulation of Research Design	5
3	Meaning and sources of Research problem, characteristics of good Research problem, Research process, outcomes, application of Research	3
4	Literature Review Process – Role, importance, sources, methods, software tools for literature review. Formulation of Research Problem	2

5	Research Design – Meaning, Need, Types of research design – Exploratory, Descriptive, components of research design and features of good research design.	5
6	Sampling: Sampling design: Meaning, logic and application of sampling.	3
7	Data Collection Methods: Types and Sources of Data	5
9	Data Analysis: Organization and presentation of data, Data Analysis Methods	2
10	Presentation and Publication of Research: Research Proposal, Research Paper, Research Thesis, Research Report, Report Writing, Format for writing reports, bibliography, and references	3

References

Sr.No	Book Name	Author	Publisher
1	Research methodology techniques and methods https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf	C R Kothari	New age International publishers.
2	Probability and Statistics for Engineers and Scientists	Sheldon Ross	Elsevier Academic Press
3	Research Methodology	R. Panneerselvam	PHI, New Delhi 2005
4	Researching Information Systems and Computing,	Oates B J	Sage Publications
5	https://onlinecourses.nptel.ac.in/noc22_ge08/preview		

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS51302	Course Name: Practical on Research Methodology	Total Hours: 30
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> • Basic knowledge of Computer Science Subjects 	
Course Objectives:	<ul style="list-style-type: none"> • To enable students to publish research paper 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> • Understand research terminology • publish research paper/ research article 	
Chapter	Course Contents	Number of Sessions
1	ICT Tools for Research Use of Internet in Research: Browsing the internet through standard features, Accessing and Downloading information, E-resources for research, Impact Factor: E - Information, H-Index, citation index, , e-journals etc	3
2	Identification of Research Problem and Literature Survey , Various Referencing Styles	4
3	Publishing a research paper	3

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52101	Course Name: Software Testing Using Manual and Automated Tools	Total Lectures: 60
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Analytical and logical skills. ● Time Management. ● Organisational skills. ● Communication skills. ● Basic knowledge of Database/ SQL. ● Basic knowledge of Linux commands. 	
Course Objectives:	<ul style="list-style-type: none"> ● To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods. ● To discuss various software testing issues and solutions in software unit test; integration, regression, and system testing. ● To learn how to plan a test project, design test cases and data, conduct testing operations, manage software problems and defects, and generate a testing report. ● To expose the advanced software testing topics, such as object-oriented software testing methods, and component-based software testing issues, challenges, and solutions. ● To gain software testing experience by applying software testing knowledge and methods to practice-oriented software testing projects. ● To understand software test automation problems and solutions. ● To learn how to write software testing documents, and communicate with engineers in various forms. 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● List a range of different software testing techniques and strategies and be able to apply specific(automated) unit testing methods to the projects. ● Distinguish characteristics of different types of testing methods. ● Create test templates and use them for any module. 	
Chapter	Course Contents	Number of Lectures
1	Introduction to Testing and Software Model <ul style="list-style-type: none"> ● Introduction to Software Testing ● Objectives of Software Testing 	6

	<ul style="list-style-type: none"> ● Types of Software Testing ● SDLC Model ● Waterfall Model ● V-Model ● Prototype Model ● Agile Model ● How to choose which model is best suited for your project 	
2	<p>Types of Testing</p> <ul style="list-style-type: none"> ● Unit Testing ● Integration Testing ● System Testing UAT Testing ● Software Testing Methods ● Used in Industry White Box Testing Black Box Testing ● An introduction or familiarization of various popular testing types ● Regression Testing ● Ad-hoc Testing ● Smoke Testing ● Sanity Testing ● Usability Testing ● Exploratory Testing ● Compatibility Testing ● Installation Testing ● Non-Functional Testing of Load Testing on Stress Testing <ul style="list-style-type: none"> o Volume Testing ● Database Testing ● Functional testing vs. non-functional testing...etc. 	10
3	<p>Software Testing Life Cycle</p> <ul style="list-style-type: none"> ● Overview of the stages of STLC ● Test planning ● Test design ● Test execution ● Test Plan walkthrough - Live Project document ● Practical tips on how to identify the following items for the Test plan: <ul style="list-style-type: none"> ○ Scope ○ Test strategy ○ Effort Estimation ○ Entry criteria ○ Exit Criteria ● Defect Management process 	8
4	<p>Test Templates creation and use</p> <ul style="list-style-type: none"> ● Test scenario template ● Test case template ● Test plan Defect report Status report...etc ● Test scenario creation – what are they, how to write them, why, when etc. ● Test documentation review- How to perform Peer reviews ● Test cases creation 	8

	<ul style="list-style-type: none"> ● Test case design techniques ● Boundary Value analysis ● Equivalence partitioning ● Error guessing o ● Types of parameters 	
5	Traceability Matrix <ul style="list-style-type: none"> ● Test execution ● Defect management ● Finding defects ● Logging defects ● Tracking and managing defects ● Defect lifecycle ● Test reporting ● Daily status reports ● Test metrics ● User Acceptance Testing(UAT) ● QA team's role UAT plan ● UAT execution , ● Go/no-go decisions Classes 	8
6	Automation testing Tool <ul style="list-style-type: none"> ● Selenium ● Programming languages: Python, Java, JavaScript, C#, Ruby ● regression testing ● load testing ● stress testing ● UI Testing ● API Testing 	20

References

Sr. No.	Book Name	Author	Publication
1	Learning Selenium IDE Automation Testing Tool	Parveen	Kindle Edition
2	Selenium WebDriver 3 Practical Guide: End to- end automation testing for web and mobile browsers with Selenium WebDriver	Unmesh Gundecha , Satya Avasarala	2nd Kindle Edition
3	Software Testing Principles and practices-	Srinivasan Desikan and Gopalaswami Ramesh	Pearson Education India
4	Practical Approach of Software Testing	Amol Prakash Ujagare	Adhyyan Books
5	Software Testing	Ron Patton	Second Edition SAMS Pearson Publication

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52102	Course Name: Mobile Technologies	No. of Hours: 60
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Concepts of Networking Conversant with OS internals ● Familiar with the network Protocol stack ● Gain knowledge about different mobile platform and application development ● Brief History of wireless communication 	
Course Objectives:	<ul style="list-style-type: none"> ● To impart basic understanding of the wireless communication systems. ● To expose students to various aspects of mobile and ad-hoc networks. ● To understand the issues relating to Wireless applications Understand the Mobile security 	
Course Outcomes:	<ul style="list-style-type: none"> ● Familiarize with technology of mobile communication and mobile ad-hoc networks ● Understand the GSM architecture ● Understand the issues relating to Wireless applications ● Introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensor devices 	
Chapter	Course Contents	Number of Lectures
1	Introduction to Mobile Computing <ul style="list-style-type: none"> ● Introduction and need for Mobile computing ● Mobility and portability ● Mobile and Wireless devices ● Mobile Applications ● Mobile Operating system – IOS, ● BlackBerry, Windows phone, Plam OS, Symbian OS, PhoneGap 	4

2	<p>Android Fundamentals</p> <ul style="list-style-type: none"> ● Introduction to Android - Overview and evolution of Android, Features of Android, Android architecture ● Components of an Android Application, Manifest file ● Android Activity ● Service Lifecycle 	12
3	<p>Android UI Design</p> <ul style="list-style-type: none"> ● Basic UI Designing (Form widgets, Text Fields , Layouts ,[dip, dp, sip, sp] versus px) ● Intent(in detail) ● All components (e.g Button , Slider, Image view, Toast) Event Handling ● Adapters and Widgets ● Menu 	18
4	<p>Android Thread and Notification</p> <ul style="list-style-type: none"> ● Threads running on UI thread (runOnUiThread) ● Worker thread ● Handlers & Runnable ● AsyncTask (in detail) ● Broadcast Receivers ● Services and notifications ● Toast ● Alarms 	6
5	<p>Advanced Android Programming</p> <ul style="list-style-type: none"> ● Content Providers – SQLite Programming ● JSON Parsing ● Accessing Phone Service(Call, SMS, MMS) ● Location based services 	6
6	<p>PhoneGap Programming</p> <ul style="list-style-type: none"> ● Why Use PhoneGap? ● How PhoneGap Works ● Designing for the Container ● Writing PhoneGap Applications ● Building PhoneGap Applications ● PhoneGap Limitations ● PhoneGap Plug-Ins ● Hello, World! Program ● PhoneGap APIs –1 <p>Accelerometer:</p>	14

	<ul style="list-style-type: none"> ● Querying Device Orientation, ● Watching a Device's Orientation, ● Creating a Contact, Searching for Contacts, Cloning Contacts, Removing Contacts. 	
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References

Sr.No	Book	Author	Publication
1	A Course in Machine Learning	Hal Daumé III	
2	IOS Apprentice	Matthijs Hollemans	
3	PhoneGap: Beginner's Guide	Giorgio Natili, Purusothaman Ramanujam	PACKT Publication
4	Beginning Android Application Development	Wei-Meng Lee Wiley	

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52103	Course Name: Emerging Trends in Data Science	Total Lecturers: 60
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Problem solving using computers ● Basic mathematics and statistics ● Knowledge of Databases 	
Course Objectives:	<ul style="list-style-type: none"> ● Provide students with knowledge and skills for data-intensive problem solving and scientific discovery ● Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of large data sets. ● Acquire good understanding of both the theory and applications of applied statistics and computer science based existing data science models to analyze huge data sets originating from diversified application areas. 	
Course Outcomes:	<p>After successful completion of course students will be able to:</p> <ul style="list-style-type: none"> ● Understand the basics of business analysis and Data Science Knowledge . ● Learn different types of data ● Understand data management and handling and Data Science Project Life Cycle ● Understand the data mining concept and its techniques and applications ● Detects and diagnoses common data issues, such as missing values, special values, outliers, inconsistencies, and localization. ● understand use of R software for data analysis 	
Chapter	Course Contents	Number of Lectures
1	Introduction <ul style="list-style-type: none"> ● What is Data Science? ● Historical Overview of data analysis ● Data Scientist vs. Data Engineer vs. Business Analyst, ● Career in Data Science ● Why Data Science ● Applications for data science, Data Scientists Roles and Responsibility 	10
2	Data Preprocessing <ul style="list-style-type: none"> ● Data Collection ● Data Management 	10

	<ul style="list-style-type: none"> ● Need of Data Preprocessing ● Steps of data preprocessing 	
3	Data Classification Data Science Project <ul style="list-style-type: none"> ● Life Cycle ● Business Requirement ● Data Acquisition ● Data Preparation ● Hypothesis and Modeling ● Evaluation and Interpretation, ● Deployment. 	12
4	Introduction to Data Mining <ul style="list-style-type: none"> ● The origins of Data Mining ● KDD Process ● Data Mining Tasks, issues in data mining ● Data warehousing <ul style="list-style-type: none"> ○ introduction, multidimensional data modelling ● OLAP operations 	8
5	Algorithms in Data Mining <ul style="list-style-type: none"> ● Classification <ul style="list-style-type: none"> ○ basics of classification, decision tree induction algorithms, K-Nearest neighbour ● Regression <ul style="list-style-type: none"> ○ Linear regression ● Clustering <ul style="list-style-type: none"> ○ Introduction to clustering, Kmeans algorithm ● association rule mining - Apriori algorithm, support, confidence, frequency item set 	8
6	Introduction to R <ul style="list-style-type: none"> ● R Programming Basics, ● Programs using List & Vectors, ● Matrix, String and Factors, ● Program using data frame and visualization for classification, regression and association rules 	12

References

Sr. No.	Book Name	Author	Publication
1	Data Mining: Concepts and Techniques	Jiawei Han and Micheline Kambe	Academic Press, Morgan Kaufmann Publishers
2	An Introduction to R	W. N. Venables, D. M. Smith and the R	R-intro.pdf (r-project.org)
3	Data Mining & Data Science	Dr. Dipali Meher, Dr.	Nirali Publication

		Pallawi Bulakh	
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Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- I		
Course Code: COMCS52104	Course Name: Data Science Practical	Total Hours: 30
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Problem solving using computers ● Basic mathematics and statistics ● Knowledge of Databases ● Basic knowledge of Procedure Oriented Programming 	
Course Objectives:	<ul style="list-style-type: none"> ● Provide students with knowledge and skills for data-intensive problem solving and scientific discovery using R software 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● learn how R software will be used for data science purpose 	
Chapter	Course Contents	Number of Sessions
1	R Assignment using data frames,vectors,strings and bar plot	1
2	Data Pre-processing Assignment	1
3	Data Classification Assignment	2
4	Regression Assignment	2
5	Association Rules Assignment	2
6	Clustering Assignment	2

References

Sr.No	References

1	Data Preprocessing With R: Hands-On Tutorial (analyticsindiamag.com)
2	R for Statistical Learning (daviddalpiaz.github.io)
3	How to Build a Complete Classification Model in R and caret by Angelica Lo Duca Towards Data Science
4	Introduction to Association Rule Mining in R Jan Kirenz
5	Association Rule Mining in R. Association Rule Mining (also called as... by Avinash Kadimisetty Towards Data Science
6	Clustering in R - A Survival Guide on Cluster Analysis in R for Beginners! - DataFlair (data-flair.training) A Guide to Clustering Analysis in R (dominodatalab.com)

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52201	Course Name: Machine Learning	Total Lectures: 30
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Familiarity with Probability Theory, Multivariable Calculus, Linear Algebra ● Programming in Python (NumPy, SciPy, Pandas, Matplotlib, Seaborn, SciKit-Learn, Stats Model) 	
Course Objectives:	<ul style="list-style-type: none"> ● To introduce students to the basic concepts and techniques of Machine Learning. ● To write python programs using machine learning algorithms for solving practical problems. ● To understand about Machine Learning Library and use cases. ● To understand the process of deploying an ML model. 	
Course Outcomes:	<p>After successful completion of course students will be able to:</p> <ul style="list-style-type: none"> ● Recognize the characteristics of machine learning that make it useful to real-world problems. ● Process available data using python libraries and predict outcomes using Machine Learning algorithms to solve given problems. ● Able to estimate Machine Learning models efficiency using suitable metrics. ● Design application using machine learning techniques. 	
Chapter	Course Contents	Number of Lectures
1	Introduction to Machine Learning <ul style="list-style-type: none"> ● Data Science, Artificial Intelligence and Machine Learning ● Why Learn and What is Learning, What is Machine Learning Traditional Programming Vs. Machine Learning, Machine Learning Process, Types of Data, Key Elements of Machine Learning (Representation, Evaluation and Optimization), Dimensionality Reduction (Feature Reduction) ● Descriptive and Inferential Statistics: Probability, Distribution, Distance Measures (Euclidean and Manhattan), 	8

	<p>Correlation and Regression, Hypothesis Testing.</p> <ul style="list-style-type: none"> ● Introduction to Numpy,Pandas and Scikit library ● Creating our own dataset, Importing the dataset, Handling Missing Data, Splitting the dataset into the Training set and Test set, Feature Scaling ● Relations of ML with other fields (Data Mining, Data Warehousing, Artificial Intelligence, Statistics) 	
2	<p>Machine Learning Models</p> <ul style="list-style-type: none"> ● Type of Learning- Supervised, Unsupervised and Semi- Supervised Learning ● Components of Generalization Error (Bias, Variance, underfitting, overfitting) ● A Learning System Cycle and Design Cycle ● Metrics for evaluation viz. accuracy, scalability, squared error, precision and recall, likelihood, posterior probability ● Classification Accuracy and Performance 	6
3	<p>Regression Models</p> <ul style="list-style-type: none"> ● Linear Regression - Simple ,Multiple, Polynomial ● Non-linear Regression – Decision Tree, Support Vector, Random Forest 	4
4	<p>Classification Models</p> <ul style="list-style-type: none"> ● K – Nearest Neighbors (KNN) ● Naive Bayes Theorem 	4
5	<p>Clustering Models</p> <ul style="list-style-type: none"> ● K-means ● Hierarchical Clustering (Agglomerative,Divisive),Dendrogram 	4
6	<p>Association Rules</p> <ul style="list-style-type: none"> ● Key Terms: Support, Confidence and Lift ● Apriori Algorithm 	4

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Machine learning	WCB Mitchell, Tom M	McGraw Hill Education

2	A first course in machine learning	Rogers, Simon, and Mark Girolami	CRC Press, 2015
3	The elements of statistical learning.	Friedman, Jerome, Trevor Hastie, and Robert Tibshirani	Springer, Berlin: Springer series in statistics, 2001
4	Machine learning course material	Andrew Ng	Stanford university

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52202	Course Name: Machine Learning Practical	Total Hours: 30
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits:2
Course Prerequisites:	<ul style="list-style-type: none"> ● Basic knowledge of distributed computing system ● Knowledge of virtualization concept 	
Course Objectives:	<ul style="list-style-type: none"> ● To enable students to undertake independent research of a business problem, and to analyze and present their findings. ● To familiarize students with the basic techniques of collection, analysis, interpretation and presentation of data. ● To formulate a research proposal for a business project. ● To obtain knowledge of research methodology 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Understand research terminology ● Be aware of the ethical principles of research, ethical challenges and approval processes ● Describe quantitative, qualitative and mixed methods approaches to research ● Identify the components of a literature review process ● Critically analyze published research 	
Sr.No.	Course Contents	Number of Sessions
1	Write a python program to Prepare Scatter Plot (Use Forge Dataset / Iris Dataset)	1
2	Write a python program to find all null values in a given data set and remove them.	1

3	Write a python program the Categorical values in numeric format for a given dataset.	1
4	Write a python program to implement Simple linear Regression for predicting house price.	1
5	Write a python program to implement Polynomial Regression for a given dataset.	1
6	Write a python program to Implement Naïve Bayes for a given dataset.	1
7	Write a python program to implement linear SVM for a given dataset.	1
8	Write a python program to implement Decision Tree Algorithm for a given dataset.	1
Data Sets for ML – UCI Machine Learning Repository – www.kaggle.com		

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -I Semester- II		
Course Code: COMCS52401	Course Name: On Job Training/Field Project	Total Sessions: 10
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4
Course Prerequisites:	<ul style="list-style-type: none"> ● Basic Knowledge of any programming language ● Basic Knowledge of Database Management Systems 	
Course Objectives:	<ul style="list-style-type: none"> ● Enriching the experiences of College students by linking academic studies in the classroom with real practical situations in the work environment. ● Providing the opportunity for students to discover their professional interests in the field of their academic specialization. ● Emphasizing the effectiveness of field training in preparing post graduate students for their practical future. 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> ● Demonstrate a sound technical knowledge of their selected project topic. ● Undertake problem identification, formulation and solution. ● Design applications for selected topics using agile approach ● partially/fully develop an artifact of problem under study 	
Session no.	Course Contents	Number of sessions
1	Assignment on Excel - I	1
2	Assignment on Excel - II	1
3	Assignment on SQL - I	1
4	Assignment on SQL - II	1
5	Assignment on Python - I	1

6	Assignment on Python - II	1
7	Assignment on Visualization Tool - I	1
8	Assignment on Visualization Tool - I	1
9	Case Study - I	1
10	Case Study - II	1

References

Sr. No.	Title of the Book	Author/s & Publication
1	Development Project Management	Microsoft Word - PM4DEV - Development Project Management
2	Project Information Management Systems	Microsoft Word - PM4DEV - Project Information Management Systems.doc
3	Organizational Project Management	Microsoft Word - PM4DEV - Organizational Project Management.doc
4	Project Budget Management	Microsoft Word - PM4DEV - Project Budget Management.doc
5	Project Quality Management	Microsoft Word - PM4DEV - Project Budget Management.doc

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- III		
Course Code: COMCS6310 1	Course Name: Software Architecture and Design Patterns	Total Lectures (60 Hours)
Teaching Scheme: 4 hrs/week	Examination Scheme: IA: 40 Marks CE: 60 Marks	No. of Credits: 4
Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> ● Familiarity with UML and OOPs Concepts ● Programming in Java 	
Course Objectives:	<ul style="list-style-type: none"> ● To introduce students to the basic concepts and techniques of SADP. ● To write java programs using Design Pattern and Frameworks to create reusable and flexible software systems. ● Use of patterns and architectures for solving practical problems. ● To understand design patterns. ● To understand about the process of deploying web apps using specific Frameworks. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> ● Recognize the characteristics of patterns that make it useful to solve real-world problems. ● Process available data using python libraries and predict outcomes using Machine Learning algorithms to solve given problems. ● Able to use specific frameworks as per applications need. ● Design java application using design pattern techniques. 	
Chapter	Course Contents	No. of Lectures
1	Introduction	3

	<ul style="list-style-type: none"> ● UML The Notation ● Process Unified Process / Rational Unified Process inception, elaboration, construction, transition ● How various components fit in the life cycle The artifacts at end of each process / discipline 	
2	Software Architecture <ul style="list-style-type: none"> ● What Software Architecture is and what it isn't. ● Why is architecture important? ● Architectural structures and views ● Architectural styles 	5
3	Architectural Styles <ul style="list-style-type: none"> ● Pipes and Filters ● Data Abstraction and Object – Oriented organization Event based-implicit invocation Layered Systems ● Repositories ● Interpreters 	5
4	Introduction to Patterns <ul style="list-style-type: none"> ● What is a Pattern & Design Pattern ● Characteristics of Design Patterns ● What makes a Pattern (GOF) ● Describing Design Patterns. ● Pattern Categories & Relationships between Patterns. ● Organizing the Catalog. ● Patterns and Software Architecture. 	10
5	Study of Design Patterns <ul style="list-style-type: none"> ● Creational Patterns-singleton, factory method, abstract factory ● Structural Patterns-adapter, decorator, facade ● Behavioral Patterns-iterator, observer, strategy, command and state (study of intent, applicability, participants, structure, collaboration , Java Example code , Implementation and consequences) 	20
6	GRASP (General Responsibility Assignment Software Patterns) <ul style="list-style-type: none"> ● Expert, Creator, High Cohesion, Low Coupling ● Controller, Polymorphism, Pure Fabrication, Indirection ● Don't Talk to Strangers 	07
7	Case Study (any one of the web Architecture) Take a Framework and find Patterns in the Framework.	10

Sr. No.	Title of the Book	Author/s	Publication
1	Head First Design Publisher:	Pattern Kathy Sierra, Bert Bates, Elisabeth Robson, Eric Freeman	O'Reilly Media, Inc
2	Software Architecture- Perspectives on an emerging discipline	Mary shaw and David Garlan	Pearson
3	Design Patterns – Elements of Reusable Object-oriented Software	E. Gamma, Richard Helm, Ralph Johnson , John Vlissides (GoF)	Addison-Wesley Professional

4	Pattern – Oriented Software Architecture (POSA) Volume 1	Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal.	Wiley
5	Software Architecture in Practice	Len Bass, Paul Clements, Rick Kazman	Pearson Addison-Wesley Professiona
6	Applying UML and Patterns	Craig Larman.	PHI

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- III		
Course Code: COMCS6310 2	Course Name: Principles of Product Management	Total Lectures (60 Hours)
Teaching Scheme: 4 hrs/week	Examination Scheme: IA: 40 Marks CE: 60 Marks	No. of Credits: 4
Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> Basic understanding of technology and the development process Being able to conduct market research, gather customer insights, and analyze data 	
Course Objectives:	Understanding of business principles and strategy Understand the role of Product Manager	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> Think long-term and set a clear vision for the product's future. Learn about Product managers and their work with cross-functional teams, leadership and teamwork skills. Learn about listening actively to customer feedback. Think about their product plans with the company's overall goals and strategies. 	
Chapter	Course Contents	No. of Lectures
1	Introduction to Product Management <ul style="list-style-type: none"> What is product management? The role of a product manager The product life cycle Key skills and qualities of a successful product manager. 	4
2	Market Research and Analysis <ul style="list-style-type: none"> Customer segmentation and personas. 	4

	<ul style="list-style-type: none"> ● Market trends and competitive analysis. ● Conducting surveys, interviews, and usability testing. 	
3	Product Strategy <ul style="list-style-type: none"> ● Defining the product vision and mission. ● Setting product goals and objectives. ● Creating a product roadmap. 	4
4	Ideation and Concept Development <ul style="list-style-type: none"> ● Generating and evaluating product ideas. ● Prioritizing features and concepts. ● Building a business case. 	4
5	Product Development and Lifecycle <ul style="list-style-type: none"> ● Agile and Scrum methodologies. ● MinimumViable Product (MVP) concept. 	4
6	Product Strategy <ul style="list-style-type: none"> ● Setting product goals and objectives. ● Creating a product roadmap. ● Defining the value proposition. ● Pricing and monetization strategies. 	8
7	User Experience (UX) and Design <ul style="list-style-type: none"> ● User interface (UI) design. ● User testing and feedback. ● Usability and accessibility. ● Design thinking principles. 	8
8	Agile and Scrum Methodologies <ul style="list-style-type: none"> ● Introduction to Agile and Scrum. ● Scrum roles and ceremonies. ● Agile project management tools 	8
9	Product Development and Engineering <ul style="list-style-type: none"> ● Working with development teams. ● Agile project management. ● Release planning and scheduling. ● Managing technical debt. 	8
10	Go-to-Market Strategy <ul style="list-style-type: none"> ● Product launch planning. ● Marketing and promotion. ● Sales enablement. ● Distribution channels. 	8

References

Sr. No.	Title of the Book	Author/s	Publication
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1	Fundamentals of Selling	Charles M. Futrell	Tata McGraw Hill 10th Edition
2	Product Leadership	Richard Banfield, Martin Eriksson, and Nate Walkingshaw	O'reilly
3	Inspired: How to Create Products Customers Love	Marty Cagan	Wiley

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- III		
Course Code: COMCS6310 3	Course Name: Cryptography and Test Cases	Total Lectures: (60 Hours)
Teaching Scheme: 4 hrs/week	Examination Scheme: IA: 40 Marks CE: 60 Marks	No. of Credits: 4
Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> ● Basic concepts of networking ● TCP/IP protocol suite 	
Course Objectives:	<ul style="list-style-type: none"> ● Explain the objectives of information security ● Explain the importance and application of each of confidentiality, integrity, authentication and availability . ● Understand various cryptographic algorithms. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> ● Understand basic cryptographic algorithms, message and web authentication. ● Identify information system requirements for both of them such as client and server and security issues.. 	
Chapter	Course Contents	No. of Lectures
1	Security Concepts <ul style="list-style-type: none"> ● Introduction, ● The need for security, ● Security approaches, 	7

	<ul style="list-style-type: none"> Principles of security, Types of Security attacks 	
2	Cryptography Concepts and Techniques <ul style="list-style-type: none"> Introduction, Plain text and cipher text, Substitution techniques, Transposition techniques, Encryption and decryption, Symmetric and asymmetric key cryptography, Steganography 	10
3	Symmetric key Ciphers <ul style="list-style-type: none"> Block Cipher Stream ciphers 	3
4	International data Encryption Algorithm(IDEA) and DES <ul style="list-style-type: none"> History of International Data Encryption Algorithm (IDEA) Basic similarities and differences between International Data Encryption Algorithm (IDEA)and Data Encryption Standard (DES) Advanced Encryption Standard (AES) 	10
5	Message Digest <ul style="list-style-type: none"> What Are The Requirements Of A Message Digest? Message-Digest Algorithm Secure Hash Algorithm (SHA) Comparison Of MD5 And SHA 	10
6	Digital Signatures and Digital Certificates <ul style="list-style-type: none"> What is a Digital Signature? Applications Drawbacks of Digital Signatures What is a digital certificate? Digital certificate creation 	10
7	RSA <ul style="list-style-type: none"> What is RSA? ? RSA algorithm steps Solving Examples using RSA algorithm 	3
8	Authentication techniques <ul style="list-style-type: none"> Types of authentication Passwords Authentication token <ul style="list-style-type: none"> Certificate-based authentication Use of Smart Cards Biometric authentication 	4
9	Firewalls <ul style="list-style-type: none"> Introduction to Firewalls Types of Firewalls Demilitarized Zone (DMZ) 	3

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Cryptography and Network Security	Atul Kahate	McGraw Hill
2	Cryptography and Network Security - Principles and Practice	William Stallings	Pearson Education
3	Cryptography and Network Security	Forouzan Mukhopadhyay	McGraw Hill

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -II Semester- III		
Course Code: COMCS631 04	Course Name: SADP Practical Using JAVA	Total Practical's: 10
Teaching Scheme: 4 hrs/week	Examination Scheme: IA: 20 Marks CE: 30 Marks	No. of Credits: 2
Course Prerequisites	<ul style="list-style-type: none"> • Programming in Java • Programming in C, CPP 	
Course Objectives:	<ul style="list-style-type: none"> • To write java programs using Design Pattern and Frameworks to create reusable and flexible software systems. 	
Course Outcomes:	After successful completion of course students will be able to: <ul style="list-style-type: none"> • Able to use specific frameworks as per applications need. • Design java application using design pattern techniques. 	
	Software Architecture & Design Pattern List of Assignments	
Assignment Number	Assignment Name	Number of Sessions
1	Virtual Lab Assignment Software Engineering Virtual Lab List of experiment <ol style="list-style-type: none"> 1. Modeling UML USE case Diagrams and Capturing Use Case Scenarios http://vlabs.iitkgp.ernet.in/se/ 2. Identifying Domain Classes From the Problem Statements 3. Modeling UML class diagram and sequence diagram 4. State Chart and Activity Modelling 5. Identifying the requirements from problem statements 6. ER Modelling from problem statements 	7
2	Write a Java Program to implement I/O Decorator for converting uppercase letters to lowercase letters.	
3	Write a Java Program to implement Singleton pattern for multithreading.	
4	Write a Java Program to implement an undo command to test Ceiling fan.	
5	Write a Java Program to implement command pattern to test Remote Control.	
6	Write a Java Program to implement Abstract Factory Pattern for Shape interface	1

7	Write a Java Program to implement Decorator Pattern for interface Car to define the assemble() method and then decorate it to Sports car and Luxury Car	
8	Write a Java Program to create shape interface and concrete classes implementing the shape interface(circle,square,rectangle). Use this code to implement factory method	1
9	Write a Java Program to implement facade pattern	1

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -II Semester- III		
Course Code: COMCS63201	Course Name: Project	No. of Credits: 2
Teaching Scheme: 2 hrs/week	Examination Scheme: IA: 20 Marks CE: 30 Marks	
Teaching Scheme: Project: 2 hours/week Batch Size: 5 students		
Workload :		
<ul style="list-style-type: none"> ● One project guide to be assigned to 5 students. ● 2 hours /week to be allotted for 5 students 		

Guidelines:

- Students should work in a team of minimum 2 and maximum 3 students.
- Students can choose a project topic without any restriction on technology or domain.
- The student group will work independently throughout the project work including: problem identification, information searching, literature study, design and analysis, implementation, testing, and the final reporting.
- Project guide must conduct project presentations (minimum 2) to monitor the progress of the project groups.
- At the end of the project, the group should prepare a report which should conform to international academic standards. The report should follow the style in academic journals and books, with clear elements such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report.
- The final project presentation with demonstration (UE) will be evaluated by the project guide (appointed by the college) and one external examiner (appointed by the University).

Evaluation guidelines:

IA (15 marks)			UE (35 marks)		
First presentation	Second presentation	Documentation	Project Logic/Presentation	Documentation	Viva
5	5	5	20	5	10

Recommended Documentation contents:

Abstract

Introduction

- motivation
- problem statement
- purpose/objective and goals
- literature survey
- project scope and limitations System analysis
 - Existing systems
 - scope and limitations of existing systems
 - project perspective, features
 - stakeholders
 - Requirement analysis - Functional requirements, performance requirements, security requirements etc.

System Design

- Design constraints
- System Model: UML diagrams
- Data Model
- User interfaces

Implementation details

- Software/hardware specifications

Outputs and Reports

Testing

- Test Plan, Black Box Testing or Data Validation Test Cases, White Box Testing or Functional Validation Test cases and results

Conclusion and Recommendations

Future Scope

Bibliography and References

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year -II Semester- III		
Course Code: COMCS63202	Course Name: Project Related Assignments	Total Lectures: (30 Hours)
Teaching Scheme: 2 hrs/week	Examination Scheme: IA: 20 Marks CE: 30 Marks	No. of Credits : 2
Teaching Scheme <ul style="list-style-type: none"> • 2 lectures/week 		
Workload : <ul style="list-style-type: none"> • 2 lectures/week 		

Guidelines:

- The project assignments are a compulsory part of the project course and should be carried out by each project group.
 - Project assignments are to be given by the guide for continuous internal evaluation.
 - The project assignments are to be allotted to each group separately by the project guide on the basis of the implementation technology. A suggested list of assignments is given below.
2. Project Time management: plan (schedule table), Gantt chart, Roles and responsibilities, data collection, Implementation
 3. Simple assignments to evaluate choice of technology
 4. Assignments on UI elements in chosen technology
 5. Assignments on User interfaces in the project
 6. Assignments on event handling in chosen technology
 7. Assignments on Data handling in chosen technology
 8. Online and offline connectivity
 9. Report generation
 10. Deployment considerations
 11. Test cases

Each student within the group must work actively and contribute to the assignments,
project work and report writing.

Evaluation guidelines:

IA (15 marks)		UE (35 marks)	
Attendance	Assignments	Assignments	Viva
5	10	25	10

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- III		
Course Code: COMCS6410 1	Course Name: Research Project	Total Lectures: 60 Hours
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4

Course Prerequisites :	Student should have basic knowledge of: <ul style="list-style-type: none"> Performing literature survey in various reputed journals knowledge of any database technology and programming language 	
Course Objectives:	<ul style="list-style-type: none"> Explain the importance of research in computer science and also in multidisciplinary subjects Understand the research problem under study and perform rigorous literature survey of the research problem Understand the importance of research ethics and integrate research ethics into the research process. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> Write research proposals for research problem Publish research papers/ abstracts on research problem in various national/international conferences/ reputed journals 	
Chapter	Course Contents	No. of Sessions
1	Explain and apply research terms; describe the research process and the principle activities, skills and ethics associated with the research problem.	1
2	Perform literature survey on problem under study	1
3	Use various data collection methods and perform data collection step for research problem	2
4	perform a research study and justify the theory as well as the methodological decisions, including sampling and measurement.	1
5	Perform data analysis by applying various algorithms	1
6	Design and develop computer based artifact	1
7	Write research report	2
8	Publish research paper	2

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS6410 1	Course Name: Business Intelligence	Total Lectures: 60 Hours
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4

Course Prerequisites :	Student should have basic knowledge of:	
	<ul style="list-style-type: none"> ● Software Engineering, Data mining & Data Science 	
Course Objectives:	<ul style="list-style-type: none"> ● Understand the role of BI in enterprise performance management and decision support. ● Understand the applications of data mining and intelligent systems in managerial work. ● Understand data warehousing and online analytical processing (OLAP) concepts, including dimensional modeling, star and snowflake schemas, attribute hierarchies, metrics, and cubes. ● Learn data analysis and reporting using an available BI software. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> ● Describe the concepts and components of Business Intelligence (BI). ● Critically evaluate use of BI for supporting decision making in an organisation. ● Understand and use the technologies and tools that make up BI. 	
Chapter	Course Contents	No. of Lectures
1	Introduction to Business intelligence <ul style="list-style-type: none"> ● Definition and History of BI ● Transaction processing versus analytical processing ● BI implementation ● Major tools and techniques of BI 	06
2	Data Warehousing <ul style="list-style-type: none"> ● Definition and concepts ● Data warehouse architecture ● ETL process, data warehouse development ● Top down vs. Bottom up ● Data Mart vs. EDW ● Implementation issues ● Real-time data warehousing 	10
3	Business Performance Management <ul style="list-style-type: none"> ● Key performance indicators and operational metrics ● Balanced scorecard ● Six Sigma ● Dashboards and scorecards 	14
4	Data Mining for Business Intelligence <ul style="list-style-type: none"> ● Data mining process ● Data mining methods ● ANN for Data Mining 	10
5	Text, and Web mining for Business intelligence <ul style="list-style-type: none"> ● Text mining Applications ● Process and Tools ● Web content ● structure and usage mining 	08

6	BI implementation , Integration and emerging trends <ul style="list-style-type: none"> ● Implementing BI ● BI Application Life Cycle ● Connecting BI to Enterprise systems ● On- demand BI, Issues of legality ● privacy and Ethics ● Emerging topics in BI ● Social Networking and BI ● RFID and BI 	10
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References:

Sr. No.	Title of the Book	Author/s	Publication
1	Business Intelligence: A Managerial Approach,	EfrainTurban, Ramesh Sharda, Dursun Delen, and David King	2nd Edition, PEARSON 2012
2	Oracle Business Intelligence Applications	Simon Miller, William Hutchinson ISBN-10: 93-5134-153-4 ISBN-13: 978-93-5134-15	McGraw Hill Education 2013

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS64102	Course Name: DevOps	Total Lectures: 60 Hours
Teaching Scheme:	Examination Scheme: CIE: 40 Marks	No. of Credits: 4

4 hrs/week	ESE: 60 Marks	
Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> ● Windows Operating Systems ● Programming Languages like C, CPP, Java ● Software Engineering 	
Course Objectives:	<ul style="list-style-type: none"> ● To introduce students' basic techniques and concepts of DevOps and Version Control Systems ● To improve quality and performance of the applications using version control systems 	
Course Outcomes:	<p>After successfully completing this course, students will be able to:</p> <ul style="list-style-type: none"> ● Understand the essential characteristics of DevOps ● Study the concepts like importance of Continuous Integration and Continuous Delivery, Infrastructure as Code, Test Driven Development, Behaviour Driven Development. ● Understand the basics of GIT, its various commands and its installations of GIT and Docker. 	
Chapter	Course Contents	No. of Lectures
1	Introduction to DevOps <ul style="list-style-type: none"> ● Define Devops ● What is Devops ● SDLC models, Lean, ITIL, Agile ● Why Devops? ● Devops Stakeholders ● Devops Goals ● Important Terminology ● Devops Perspective ● Configuration Management ● Continuous Integration and Deployment 	25
2	Version Control-GIT <ul style="list-style-type: none"> ● Introduction to GIT ● What is Git ● About Version Control System and Types ● Difference between CVCS and DVCS ● GIT Basics ● GIT Command Line 	10
3	GIT Installation <ul style="list-style-type: none"> ● Installing Git ● Installing on Windows ● Initial Setup ● Git Essentials ● Creating Repository ● Cloning, Check-in and Committing ● Fetch Pull and Remote ● Branching 	25

References:

Sr. No.	Title of the Book	Author/s	Publication
1	DevOps for Developers	Michawl Huttermann	Apress
2	DevOps: A Software Architect's Perspective	Len Bass, Ingo Weber, Liming Zhu	Pearson
3	Building DevOps culture	Mandi Walls	O'reilly

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS64103	Course Name: DevOps Practical	Total Practicals: 10
Teaching Scheme: 4 hrs/week	Examination Scheme: CIE: 40 Marks ESE: 60 Marks	No. of Credits: 4

Course Prerequisites:	Student should have basic knowledge of: <ul style="list-style-type: none"> • Windows Operating Systems • Programming Languages like C, CPP, Java • Software Engineering 	
Course Objectives:	<ul style="list-style-type: none"> • To introduce students basic techniques and concepts of DevOps and Version Control Systems • To improve quality and performance of the applications using version control systems 	
Course Outcomes:	<p>After successfully completing this course, students will be able to:</p> <ul style="list-style-type: none"> • Understand the essential characteristics of DevOps • Study the concepts like importance of Continuous Integration and Continuous Delivery, Infrastructure as Code, Test Driven Development, Behaviour Driven Development. • Understand the basics of GIT, its various commands and its installations of GIT and Docker. 	
Chapter	Course Contents	No. of Sessions
1	Installation of GIT on Windows	3
2	GIT Command Line	4
3	Creating Repository	3

References:

Sr. No.	Title of the Book	Author/s	Publication
1	DevOps for Developers	Michawl Huttermann	Apress
2	DevOps: A Software Architect's Perspective	Len Bass,Ingo Weber, Liming Zhu	Pearson
3	Building DevOps culture	Mandi Walls	O'reilly
	A Practical Guide To Git And GitHub For Windows Users: From Beginner Expert In Easy Step By Exercises & Hub (usermanual.wiki) How to Download & Install GIT Tutorial? - Practical Guide (acte.in)		

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS64201	Course Name: Web Frameworks	Total Lectures: 30 Hours
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> ● Basic knowledge of Java Script. ● Basics of web application development. ● Knowledge of what is Client and Server side programming. 	
Course Objectives:	<ul style="list-style-type: none"> ● To introduce students to modern web technologies. ● To learn and use server side programming using Node.js ● To understand asynchronous programming. ● To learn and understand web applications in Django a Python Web Framework. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> ● Students will be ready with the technology which is used widely in Industry as a part of full stack developer. ● Students will know the powerful way to develop the web application in Python. ● Students will understand what is asynchronous programming. ● Build and deploy a robust Django Web App. ● Integrate with Restful web services. 	
Chapter	Course Contents	No. of Lectures
1	Java Script Basics <ul style="list-style-type: none"> ● Java Script data types ● Variables, Functions, Events, Regular Expressions ● Array and Objects in Java Script ● Java Script HTML DOM ● Promises and Callbacks 	4
2	Introduction to Node JS & Modules <ul style="list-style-type: none"> ● What is Node JS, Installation of Node JS and its advantages ● Traditional Web Server Model and Node JS Process Model ● Node JS event Loop ● Functions and Buffer ● Module and Module Types ● Directories as module ● What is NPM? ● Installing and Updating packages locally and globally ● Adding dependencies in package.json 	10

3	Web Server <ul style="list-style-type: none"> ● Creating Web Server ● Handling and Streaming HTTP requests ● FS Model ● Streams ● Reading and Writing Files and Directories ● Other File Operations ● Asynchronous JS ● Asynchronous control flow with callbacks ● Promises ● EventEmitter Class ● ASync/Await ● Returning Event Emitter 	6
4	Working with Databases <ul style="list-style-type: none"> ● Connection String and Configuring ● Working with Select command and various database operations ● MongoDB ● Mongoose ODM, Mongoose Schema and Mongoose Model ● Querying with Mongoose 	5
5	Express JS <ul style="list-style-type: none"> ● REST ● Introduction to Express JS ● Routing, Responding ● Configuration ● Views ● Receiving Data ● Error Handling 	5

References:

Sr. No.	Title of the Book	Author/s	Publication
1	Node.js complete	reference guide , valentin Bojinov, David Herron, Dioge Resende	PACKT Publishing Ltd
2	Smashing Node.js, Java Script Everywhere	Guillermo Rauch, John wiley & Sons	Wiley publishing

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS6420 2	Course Name: Web Frameworks Practical	Total Practicals: 10
Teaching Scheme: 2 hrs/week	Examination Scheme: CIE: 20 Marks ESE: 30 Marks	No. of Credits: 2
Course Prerequisites:	<ul style="list-style-type: none"> Programming in Object oriented and procedure oriented programming languages and Node Js 	
Course Objectives:	<ul style="list-style-type: none"> To understand about the process of deploying web apps using specific Frameworks. 	
Course Outcomes:	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> Able to use specific frameworks as per applications need. 	
Chapter	Course Contents	No. of Sessions
1	Create an HTML form that contains the Student Registration details and write a JavaScript to validate Student first and last name as it should not contain other than alphabets and age should be between 18 to 50.	1
2	Create an HTML form for Login and write a JavaScript to validate email ID using Regular Expression.	1
3	Create a Node.js file that will convert the output "Hello World!" into upper-case letters:	1
4	Create a Node.js file that opens the requested file and returns the content to the client. If anything goes wrong, throw a 404 error	1
5	Create a Node.js file that demonstrate create database and table in MySQL	1
6	Create a node.js file that Insert Multiple Records in "student" table, and display the result object on console	2
7	Using node js create a User Login System	1
8	Write node js script to interact with the filesystem, and serve a web page from a file	1
9	Using node js create a Recipe Book	1

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
Course Code: COMCS64501	Course Name: Industrial Training	
Teaching Scheme: 6 hrs/week	Examination Scheme: CIE: 60 Marks ESE: 90 Marks	No. of Credits: 6
Course Objectives:	<ul style="list-style-type: none"> • To understand complete IT project Management 	
Course Outcomes:	<p>After successfully completing this course, students will be able to:</p> <ul style="list-style-type: none"> • Learn the basic concepts of Project & Project Management. • Become capable of self-education and clearly understand the value of achieving Perfection in the respective Project work. • Plan, schedule and execute a project considering the risk management and apply quality attributes in software development life cycle • Understand the basics of IT project Management 	
<p>The Industrial Training /Institutional project is equivalent to 5 theory courses of 4 credits each. The total weightage for Industrial/Institutional training is 150 marks.</p>		
<p>Workload : 1. One mentor to be assigned for 5 students. 2. 2 hours /week to be allotted for 5 students</p>		
<p>Guidelines:</p> <ol style="list-style-type: none"> 1. Each student must individually complete a minimum 5 months full time Industrial training / Institutional project in the 4th semester. 2. College should assign a student mentor to every student. 3. The mentor will monitor the progress of the student throughout the semester for continuous assessment. 4. Students should submit a valid offer letter and synopsis within two weeks of starting the internship. 5. There will be continuous assessment of the work done by the student during the internship period. Continuous assessment guidelines: <ol style="list-style-type: none"> a. Students should submit a weekly report in the college to the mentor. b. The report should contain the following details: Name of student, project title, company name, company mentor, daily activities and results/output, proposed work for next week. c. The weekly report should be duly signed by the student and company mentor/ institute guide (CM). d. Student Mentors should maintain a weekly attendance record for every student. e. Two presentations should be conducted for each student (first presentation after first month and second presentation after 3rd month) f. Student Mentor should take feedback from the Company mentor regarding overall performance of the student. 6. At the end of the internship period, each student should prepare a report which should conform to international academic standards. 		

7. The report should follow the style in academic journals and books, with contents such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report.

Examination and Evaluation guidelines

The project done during internship period will be evaluated in the following manner:

IA - 150 marks + UE-350 marks.

The final presentation and documentation will be evaluated by three examiners:

1. Student mentor (appointed by respective college)
2. External examiner (appointed by the College)
3. IT expert (appointed by respective college)

IA (60 marks)				
Weekly Attendance	Weekly Reports	First Presentation	Second Presentation	Documentation
10	10	10	10	20

UE (90 marks)		
Mentor	IT Expert	External Examiner
30	30	30

Recommended Documentation contents:

Title page

Company / Institute certificate

Internship completion certificate

Abstract

Introduction

- motivation
- problem statement
- purpose/objective and goals
- literature survey
- project scope and limitations System analysis
- Comparative study of Existing systems
- scope and limitations of existing systems
- project perspective, features
- stakeholders
- Requirement analysis
- Functional requirements, performance requirements, security requirements etc.

System Design

- Design constraints
- System Model: UML diagrams
- Data Model
- User interfaces Implementation details
- Software/hardware specifications, etc.

Reports

Testing Test Plan,

-Black Box Testing or Data Validation Test Cases,

-White Box Testing or Functional Validation Test cases and results

Conclusion and Recommendations

Future Scope

Bibliography and References