



**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 Applications) Part-I & II**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year**

**Part I 2023-2024**

**Part II 2024-2025**

**M.Sc. (Computer Applications)**

**Title of the Course: M.Sc. (Computer Applications)**

Preamble: This syllabus is a credit-based system to be implemented from the academic year 2024-2025. 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 Applications) 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:**

A Bachelor Degree in Science/Technology/Engineering with minimum 50% marks or equivalent for students belonging to Unreserved Category and minimum 45% or equivalent for students belonging to the Reserved Category.

**M.Sc. (Computer Applications)**

Year I Semester -I M.Sc.(Computer Applications)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCA51101	Object Oriented Programming with C++	4	-	40	60	100
Mandatory COMCA51102	Advance Databases	4	-	40	60	100
Mandatory COMCA51103	Web Technology	4	-	40	60	100
Mandatory COMCA51104	Web Technology Practical	-	2	20	30	50
Electives COMCA51201	Cloud Computing	2	-	20	30	50
Electives COMCA51202	Cloud Computing Practical	-	2	20	30	50
COMCA51301	Research Methodology	2	-	20	30	50
COMCA51302	Practical on Research Methodology	-	2	20	30	50
Total		16	6	220	330	550
Year I Semester -II M.Sc.(Computer Applications)						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCA52101	Java Programming	4	-	40	60	100
Mandatory COMCA52102	Data Warehousing & Data Mining	4	-	40	60	100
Mandatory COMCA52103	Computer Networking	4	-	40	60	100
Mandatory COMCA52104	Principles of Product Management	-	2	20	30	50
Electives COMCA52201	Python Programming	2	-	20	30	50
Electives COMCA52202	Python Programming Practical	-	2	20	30	50
COMCA52401	On Job Training/Field Project	-	4	40	60	100
Total		14	8	220	330	550
Year II Semester -III M.Sc.(Computer Applications)						

**M.Sc. (Computer Applications)**

Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCA63101	Mobile Application Development Using Android	4	-	40	60	100
Mandatory COMCA63102	Software Testing Tools	4	-	40	60	100
Mandatory COMCA63103	Data Science	4	-	40	60	100
Mandatory COMCA63104	Data Science Practical Using R	-	2	20	30	50
Electives COMCA63201	Project	2	-	20	30	50
Electives COMCA63202	Project Related Assignments	-	2	20	30	50
RP COMCA63501	Research Project	-	4	40	60	100
Total		14	8	220	330	550
<b>Year II Semester -IV M.Sc.(Computer Applications)</b>						
Course Code	Course Title	Credits		% of Assessment		
		TH	PR	CIE	ESE	Total
Mandatory COMCA64101	Business Analytics	4	-	40	60	100
Mandatory COMCA64102	DevOps	4	-	40	60	100
Mandatory COMCA64103	DevOps Practical	-	4	40	60	100
Elective COMCA64201	Introduction to Cryptography	2	-	20	30	50
Electives COMCA64202	Cryptography Practical	-	2	20	30	50
RP COMCA64501	Industrial Project/Industrial Training	-	6	60	90	150
Total		10	12	220	330	550

**Total Credits: [54(TH) + 32 (PR)] =86**

**TH:** Theory **PR:** Practical

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

Practical paper implementation strategy:

<b>Subject</b>	<b>Platform</b>
Web technology	Linux / Windows
Data Science Practical Using R	Linux
Python Programming	Linux / Windows
Cyber Security	Linux/ Windows/ AWS

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

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- I Semester- I		
<b>Course Code:</b> COMCA51101	<b>Course Name:</b> Object Oriented Programming with C++	<b>Total Lectures:60 Hours</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Procedural Language like C</li> <li>● Basic Data Structures and Algorithms.</li> </ul>	
<b>Course Objectives:</b>	To Prepare student to think about programming languages analytically to <ul style="list-style-type: none"> <li>● understand pillars of object oriented language</li> <li>● implement types of inheritance</li> <li>● learn need of operator overloading</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● understand implementation of object oriented concepts</li> <li>● implement inheritance, polymorphism, encapsulation</li> <li>● implement operator overloading</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to C++</b> <ul style="list-style-type: none"> <li>● Basics of C++,</li> <li>● Structure of C++ Program, keywords in C++,</li> <li>● Data types hierarchy in C++,</li> <li>● Operators in C++: Scope resolution operator, Insertion and Extraction operator New and Delete operators.</li> <li>● Reference variable.</li> <li>● Manipulators function: endl, setw, set fill, set precision.</li> </ul>	7
2	<b>Classes and Objects</b> <ul style="list-style-type: none"> <li>● Object oriented Concepts</li> <li>● Structure and class, Class, Object, Access specifiers,</li> <li>● Class members,</li> <li>● Defining member functions :Inside and outside the class definition</li> <li>● Creating objects. String class, operation on string, Array of objects</li> <li>● 'this' pointer.</li> </ul>	8
3	<b>Function in C++</b> <ul style="list-style-type: none"> <li>● Call by reference, Return by reference,</li> <li>● Function overloading and default arguments</li> <li>● Inline function</li> </ul>	8

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	<ul style="list-style-type: none"> <li>● Passing and returning objects from functions, Static class members Friend Concept – Function, Class</li> </ul>	
4	<b>Constructors and Destructors</b> <ul style="list-style-type: none"> <li>● Constructor</li> <li>● Types of constructors: Default, parameterized ,copy</li> <li>● Destructors</li> </ul>	5
5	<b>Operator overloading</b> <ul style="list-style-type: none"> <li>● Introduction, rules of operator overloading</li> <li>● Operator overloading:</li> <li>● Unary and binary operators,</li> <li>● Comparison, arithmetic assignment operator</li> </ul>	7
6	<b>Inheritance</b> <ul style="list-style-type: none"> <li>● Introduction</li> <li>● Types of Inheritance: Single inheritance, Multiple inheritance, Multilevel inheritance Hierarchical inheritance Hybrid inheritance.</li> <li>● Derived Class Constructors and Destructors</li> <li>● Ambiguity in multiple Inheritances, virtual base classes, Abstract base class</li> </ul>	9
7	<b>Virtual Function &amp; Polymorphism</b> <ul style="list-style-type: none"> <li>● Introduction,</li> <li>● Pointer to object, Pointer to derived class,</li> <li>● Overriding member functions,</li> <li>● Virtual function,</li> <li>● Rules for virtual functions,</li> <li>● Pure virtual function</li> </ul>	7
8	<b>Working with files</b> <ul style="list-style-type: none"> <li>● File operations – Text files, Binary files</li> <li>● File stream class and methods</li> <li>● File Updation with random access</li> </ul>	6
9	<b>Exception handling</b> <ul style="list-style-type: none"> <li>● Introduction to Exception</li> <li>● Try and catch</li> </ul>	4

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	C++: The Complete Reference	Herbert Schildt	McGraw Hill Education; 4th ed
2	Object- Oriented Programming with C++	E. Balaguruswamy	McGraw Hill Education; 8th ed
3	C/C++ Programmer's Reference	Herbert Schildt	McGraw Hill Education

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<b>Course Code:</b> COMCA51102	<b>Course Name: Advance Databases</b>	<b>Total Lectures (60 Hours)</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>Basic Knowledge of file system, storing data in file system and Operations on sets</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>To understand the fundamental concepts of databases.</li> <li>To understand user requirements and frame it in a data model.</li> <li>To understand creations, manipulation and querying of data in databases.</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>Solve real world problems using appropriate set, function, and relational models.</li> <li>Design E-R Model for given requirements and convert the same into database tables.</li> <li>Use Structured Query Language</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Procedural programming PL/PgSQL</b> <ul style="list-style-type: none"> <li>Adding PL/PgSQL to database, language structure, using variables, controlling program flow,</li> <li>Stored functions, views,</li> <li>Exception handling, concept and creation of cursor and triggers, using transaction control statements, Locks.</li> </ul>	4
2	<b>Query processing and optimization</b> <ul style="list-style-type: none"> <li>Overview of Query processing, measures of query cost,</li> <li>Selection, join, projection, evaluation of expression.</li> <li>Transformation of relational expressions,</li> <li>Estimating statistics of expression results, , choice of evaluation plans</li> </ul>	10
3	<b>Introduction to Transaction processing concepts &amp; theory</b> <ul style="list-style-type: none"> <li>Introduction, transaction and system concepts,</li> <li>Desirable properties of transactions, characterizing schedules based on recoverability,</li> <li>Characterizing schedules based on serializability, transaction support in SQL</li> </ul>	10
4	<b>Concurrency control techniques</b> <ul style="list-style-type: none"> <li>Concept of Locking and lock manager component, binary locking mechanism,</li> <li>2- phase locking techniques for concurrency control,</li> <li>C.C based on timestamp ordering, Multi-version concurrency control, Validation (optimistic) technique,</li> </ul>	8



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5	<b>Database recovery techniques</b> <ul style="list-style-type: none"> <li>● Failure classification, recovery concepts, recovery techniques based on deferred updates &amp; immediate updates,</li> <li>● Shadow paging, the Aries recovery algorithm, Database backup &amp; recovery</li> </ul>	8
6	<b>Database security</b> <ul style="list-style-type: none"> <li>● Introduction, Discretionary access control based on Grant &amp; Revoke</li> <li>● Mandatory access control &amp; role based access control for multilevel security, introduction to statistical database security</li> <li>● Introduction to flow control, challenges in database security.</li> </ul>	8
7	<ul style="list-style-type: none"> <li>●</li> </ul>	6
8	<b>Internet Databases</b> <ul style="list-style-type: none"> <li>● The worldwide web,</li> <li>● Databases and web,</li> <li>● Architecture (application servers and server side scripting), Introduction to XML</li> </ul>	6

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Database System Concepts	Henry F. Korth, Abraham Silberschatz, S. Sudarshan	Tata McGraw-Hill, 6 <sup>th</sup> Edition
2	Database Systems	Shamkant B. Navathe, Ramez Elmasr	Pearson, 5 <sup>th</sup> Edition
3	Database management systems, ,	Raghu Ramakrishnan & Johannes Gehrke	2 <sup>nd</sup> Edition
4	Principles of Distributed Database Systems,	M. Tamer Ozsu and Patrick Valduriez,	Pearson, 2 <sup>nd</sup> Edition
5	Database Management system,	Bipin Desai	
6	An introduction to database system	C. J. Date	
7	Practical Postgresql	JoshuaD. Drake, John C Worsley,	O'reilly Publication

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**M.Sc. (Computer Applications) Year -I Semester- I**

## M.Sc. (Computer Applications)

<b>Course Code:</b> COMCA51103	<b>Course Name:</b> Web technology	<b>Total Lectures</b> <b>(60 Hours)</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>• HTML</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>• To comprehend the basics of the internet and web terminologies.</li> <li>• To introduce scripting language concepts for developing client-side applications.</li> <li>• To practice server-side programming features – PHP, JSP.</li> <li>• To be familiar with database applications</li> </ul>	
<b>Course Outcomes:</b>	<p>After successfully completing this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Design and develop web applications.</li> <li>• Understand client and server-side scripting and their applicability</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Web Technologies</b> <ul style="list-style-type: none"> <li>• How Does the Website Work?</li> <li>• Software to create your website</li> <li>• What makes a good website?</li> <li>• Client-Server and its Communication</li> <li>• Client and Server Scripting Languages</li> <li>• Internet-Basic, Internet Protocols (HTTP, FTP, IP)</li> <li>• World Wide Web (WWW).</li> <li>• HTTP request message, HTTP response message</li> <li>• Types of Websites (Static and Dynamic Websites)</li> </ul>	8
2	<b>HTML</b> <ul style="list-style-type: none"> <li>• Introduction to HTML</li> <li>• HTML tags and attributes</li> <li>• Working with Elements.</li> <li>• Inserting Image</li> <li>• Client Server image mapping</li> <li>• List</li> <li>• Tables</li> <li>• Text and Image links</li> <li>• Frames</li> <li>• Forms and controls</li> <li>• Introduction with text box, text area, buttons, List box,</li> </ul>	8

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	<ul style="list-style-type: none"> <li>● radio, checkbox etc</li> </ul>	
<b>3</b>	<b>CSS</b> <ul style="list-style-type: none"> <li>● Introduction to Style Sheet</li> <li>● Introduction to Responsive Website</li> <li>● Types of CSS CSS Border, margin, Positioning, color, text, link, background, list, table, padding, image, display properties</li> <li>● Use of Id &amp; classes in CSS</li> <li>● Use of &lt;div&gt;&amp;&lt;span&gt;</li> <li>● Introduction of CSS3 : Gradients, Transitions,</li> <li>● Animations, multiple columns</li> </ul>	<b>8</b>
<b>4</b>	<b>JavaScript</b> <ul style="list-style-type: none"> <li>● Concept of script, Types of Scripts, Introduction to JavaScript</li> <li>● Variables, identifier &amp; operator, control structure.</li> <li>● Examples on JavaScript operators</li> <li>● Functions</li> <li>● Event Handling in Java Scripts</li> <li>● Concept of array, how to use it in JavaScript, types of an array, examples Event handling in JavaScript with examples</li> <li>● Math and date object and examples on it.</li> <li>● String object and examples on it, and some predefined functions</li> <li>● DOM concept in JavaScript, DOM objects</li> <li>● Validations in JavaScript, examples on it.</li> </ul>	<b>8</b>
<b>5</b>	<b>XML</b> <ul style="list-style-type: none"> <li>● Introduction to XML</li> <li>● Uses of XML</li> <li>● Simple XML,</li> <li>● XML key components</li> <li>● DTD and Schemas,</li> </ul>	<b>4</b>

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	<ul style="list-style-type: none"> <li>● Using XML with web applications.</li> <li>● Introduction to XSL, XSL elements, transforming with XSLT</li> </ul>	
<b>6</b>	<b>Introduction to PHP</b> <ul style="list-style-type: none"> <li>● Introduction to pup</li> <li>● How to install PHP Server on LINUX, WINDOWS.</li> <li>● Syntax</li> <li>● Echo, print</li> <li>● Variables, Data Types</li> <li>● Strings</li> <li>● Operators</li> <li>● Loops.</li> </ul>	8
<b>7</b>	<b>PHP Functions</b> <ul style="list-style-type: none"> <li>● Introduction to Functions</li> <li>● Types of PHP Functions</li> <li>● Defining and Calling Functions</li> <li>● Default parameters, Variable parameters, Missing parameters</li> <li>● Variable Function</li> <li>● Anonymous Function</li> </ul>	8
<b>8</b>	<b>PHP Arrays</b> <ul style="list-style-type: none"> <li>● Indexed Vs Associative arrays</li> <li>● Identifying elements of an array</li> <li>● Storing data in arrays</li> <li>● Multidimensional arrays</li> <li>● Extracting multiple values</li> <li>● Converting between arrays and variables</li> <li>● Traversing arrays</li> <li>● Sorting</li> <li>● Action on entire arrays</li> </ul>	8

**References:**

<b>Sr. No.</b>	<b>Title of the Book</b>	<b>Author/s</b>	<b>Publication</b>
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<b>1</b>	HTML Black Book	Steven Holzer,	Kromtech press.
<b>2</b>	Web Technologies, Black Book		Dreamtech Press
<b>3</b>	Web Applications: Concepts and Real-World Design,	Knuckles	Wiley-India
<b>4</b>	Internet and World Wide Web How to program,	P.J. Deitel & H.M. Deitel	Pearson
<b>5</b>	Programming PHP	Rasmus Lerdorf and Kevin Tatroe,	O'Reilly
<b>6</b>	PHP web services,		Wrox publication

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M.Sc. (Computer Applications) Year -I Semester- I**

**M.Sc. (Computer Applications)**

<b>Course Code:</b> COMCA51104	<b>Course Name: Web technology Practical</b>	<b>Total Practical (30 Hours)</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>Basic knowledge of HTML Concepts.</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>To develop an ability to design and implement static and dynamic website</li> </ul>	
<b>Course Outcomes:</b>	<p>The students will be able to:</p> <ul style="list-style-type: none"> <li>Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-hows.</li> <li>Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services.</li> </ul>	
<b>Web technology Practical Practical Assignment (CSS, JavaScript, PHP)</b>		<b>Number of Sessions</b>
1.	Write a JavaScript Program to read a number from the user, store its factors into the array and display that array. (Handle onClick Event)	2
2.	Write a JavaScript program to read a character string from the user and perform the following functions: Accept a character from the user and count the number of occurrences of that character in the string. Accept a Position from user and print the character at specified position	2
3.	Write a Java Script program to design Customer Account Details Form and perform validation on pan number field. (Pan number is of only 10 characters long, out of which first 5 characters are alphabets, next 4 characters are digits and last character is alphabet)	2
4.	Write a PHP script to set selected images from ComboBox (DropDownList) to the background of Page.	2
5.	Design HTML form, accept student Name, Age, and Mobile No. from user. Using java Script validate for following Student Name should not be empty. Student Age must be between 1 to 20.	2
6.	Write a java Script that accepts a string from the user. Pass this string as a parameter to a function name 'check_vowel' on the button click event and return the count of the number vowels within the string.	2

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7.	Write a Java Script to accept email addresses from users and count no. of @occurrences and number of DOT(.) occurrences.	2
8.	Consider the following entities and their relationship. Doctor ( doc_no, dname, address, city, area) Hospital (hosp_no, hname, hcity) Doctor-Hospital related with many-one relationship. Create a RDB in 3NF for above and solve the following. Using the above database write a script in PHP to print the Doctor visiting to the hospital in tabular format. Accept hospital name from user[ Use PostgreSQL]	2
9.	Write a java script function to Accept First Name and Last Name from the user. Display users entered information. [ Hint: use alert and prompt dialog box]	2
10.	Write a script to create an XML file as 'Employee.xml'. The element of this xml file are as follows: <Empdetails> <Employee EMPno= Empname=> <Salary> -----</Salary> <Designation> ----- </Designation> </Employee> </Empdetails>	2
11.	Write a PHP script for the following. a) Design a form to accept the details of 5 different items such as Item code, Item Name, unit, sold and Rate. Display the bill in tabular format. Use only 4 textboxes. [ Use explode]	2
12.	Design a HTML form to accept a string. Write a PHP script for the following. a) Write a function to count the total number of Vowels from the script. Show the occurrences of each Vowel from the script.	2
13.	Write a PHP script, which will return the following component of the URL 'http://www.example.com/php-example/index.php' List of component: Scheme, Host, Path <b>Excepted o/p</b> Scheme: http Host: www.example.com Path:/php-example/index.php	2
14.	Write a menu driven program to perform various file operations. Accept filename from user. a) Display type of file. Delete a file.	2
15.	Write a PHP script to keep track of the number of times the web page has been accessed. [Use Session]	2

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M.Sc. (Computer Applications) Year -I Semester- I**



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<b>Course Code:</b> COMCA51201	<b>Course Name:</b> Cloud Computing	<b>Total Lectures:</b> (30 Hours)
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits: 2</b>
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Operating System concepts</li> <li>● Fundamentals of Computer Networks</li> <li>● Good Understanding of Object-Oriented Programming Concepts</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To understand the principles and paradigm of Cloud Computing</li> <li>● To appreciate the role of Virtualization Technologies</li> <li>● Ability to design and deploy Cloud Infrastructure</li> <li>● Understand cloud security issues and solutions</li> </ul>	
<b>Course Outcomes:</b>	<p>At the end of the course, the student should be able to:</p> <ul style="list-style-type: none"> <li>● Appreciate the need for cloud computing and make decisions on using specific cloud service type and deployment models</li> <li>● Identify virtualization technologies of a cloud platform.</li> <li>● Make choices on selection of appropriate cloud service based on application requirements.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Cloud Computing</b> <ul style="list-style-type: none"> <li>● Overview, Layers and Types of Cloud</li> <li>● Desired Features of a Cloud</li> <li>● Benefits and Disadvantages of Cloud Computing</li> <li>● Cloud Infrastructure Management,</li> <li>● Infrastructure as a Service Providers</li> <li>● Platform as a Service Providers Multitenant Technology</li> <li>● Cloud-Enabling Technology: Broadband Networks and Internet Architecture, Data Center Technology, Virtualization Technology.</li> <li>● Infrastructure as a Service, Platform as a Service, Software as a Service, Cloud Deployment Models.</li> <li>● Cloud economics and benefits,</li> </ul>	8
2	<b>Abstraction and Virtualization</b> <ul style="list-style-type: none"> <li>● Introduction to Virtualization Technologies</li> <li>● Load Balancing and Virtualization</li> <li>● Understanding Hypervisors,</li> <li>● Virtual Machines -Provisioning and Manageability Virtual Machine</li> <li>● Provisioning in the Cloud Context</li> <li>● Virtualization of CPU, Memory, I/O Devices</li> <li>● Virtual Clusters and Resource management</li> </ul>	7
3	<b>Programming, Environments and Applications</b> <ul style="list-style-type: none"> <li>● Features of Cloud and Grid Platforms</li> <li>● Programming Support of Google App Engine</li> </ul>	8

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	<ul style="list-style-type: none"> <li>● Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments</li> <li>● Applications: Moving application to cloud</li> <li>● Microsoft Cloud Services</li> <li>● Google Cloud Applications</li> <li>● Amazon Cloud Services</li> </ul>	
4	<b>Security In The Cloud Security Overview</b> <ul style="list-style-type: none"> <li>● Cloud Security Challenges and Risks</li> <li>● Software-as-a-Service Security</li> <li>● Security Governance Risk Management – Security Monitoring</li> <li>● Security Architecture Design</li> <li>● Data Security</li> <li>● Application Security</li> <li>● Virtual Machine Security</li> </ul>	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

## M.Sc. (Computer Applications)

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -I Semester- I		
<b>Course Code:</b> COMCA51202	<b>Course Name:</b> Cloud Computing Practical	<b>Total Hours:</b> 30
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>• Basic knowledge of distributed computing system</li> <li>• Knowledge of virtualization concept</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>• To Obtain knowledge of cloud computing fundamentals and benefits of cloud computing</li> <li>• To Understand the various virtualization technologies in detail</li> <li>• To Understand data center and cloud storage concept</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>• Understand core issues in cloud computing such as security, privacy, and interoperability.</li> <li>• provide the appropriate cloud computing solutions and recommendations according to the applications used.</li> <li>• identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.</li> <li>• identify problems, and explain, analyze, and evaluate various cloud computing solutions.</li> </ul>	
<b>Assignment Number</b>	<b>Assignment Name</b>	<b>Number of Sessions</b>
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 Screenshots file and also write down the steps and commands used.	1
4	Practical Implementation of Storage as a Service 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.	1
5	Implementation of Storage as a Service Hosting a static website in AWS using S3.	1

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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 service . 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

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Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -I Semester- I		
<b>Course Code:</b> COMCA51301	<b>Course Name:</b> Research Methodology	<b>Total Hours: 30</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits: 2</b>
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Basic knowledge of distributed computing system</li> <li>● Knowledge of virtualization concept</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To enable students to undertake independent research of a business problem, and to analyze and present their findings.</li> <li>● To familiarize students with the basic techniques of collection, analysis, interpretation and presentation of data.</li> <li>● To formulate a research proposal for a business project.</li> <li>● To obtain knowledge of research methodology</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>● Understand research terminology</li> <li>● Be aware of the ethical principles of research, ethical challenges and approval processes</li> <li>● Describe quantitative, qualitative and mixed methods approaches to research</li> <li>● Identify the components of a literature review process</li> <li>● Critically analyze published research</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>Number of Sessions</b>
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	7
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

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<b>6</b>	Sampling: Sampling design: Meaning, logic and application of sampling.	<b>8</b>
<b>7</b>	Data Collection Methods: Types and Sources of Data	<b>8</b>
<b>9</b>	Data Analysis: Organization and presentation of data, Data Analysis Methods	<b>10</b>
<b>10</b>	Presentation and Publication of Research: Research Proposal, Research Paper, Research Thesis, Research Report, Report Writing, Format for writing reports, bibliography, and references	<b>4</b>

## References

<b>Sr.No</b>	<b>Title of the Book</b>	<b>Publishers</b>
1	Research methodology techniques and methods by C R Kothari, <a href="https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf">https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf</a>	New age International publishers.
2	Probability and Statistics for Engineers and Scientists” by Sheldon Ross, ()	Elsevier Academic Press
3	Research Methodology by R. Panneerselvam, I, New Delhi 2005	PHI
4	Oates B J – Researching Information Systems and Computing,	Sage Publications
5	<a href="https://onlinecourses.nptel.ac.in/noc22_ge08/preview">https://onlinecourses.nptel.ac.in/noc22_ge08/preview</a>	

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -I Semester- I		
<b>Course Code:</b> COMCA51302	<b>Course Name:</b> Practical on Research Methodology	<b>Total Hours: 30</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>• Basic knowledge of Computer Science Subjects</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>• To enable students to publish research paper</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>• Understand research terminology</li> <li>• publish research paper/ research article</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>Number of Lectures</b>
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

**M.Sc. (Computer Applications)**  
**M.Sc. (Computer Applications) Year- I Semester- II**

<b>Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016</b> <b>M.Sc. (Computer Applications) Year- I Semester- II</b>		
<b>Course Code:</b> COMCA52101	<b>Course Name: Java Programming</b>	<b>Total Lectures</b> <b>(60 Hours)</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● basics of how to use a computer, and should be able to start a command line shell</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To Prepare student to think about programming languages analytically to</li> <li>● To identify Java language components and how they work together in applications.</li> <li>● To design and program stand-alone Java applications</li> <li>● To learn how to design a graphical user interface (GUI) with Java Swing.</li> <li>● To understand how to use Java APIs for program development</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Understand the knowledge of java programming and object-oriented concepts</li> <li>● The use of Java in a variety of technologies and on different platforms.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Java</b> <ul style="list-style-type: none"> <li>● History and Features of Java</li> <li>● JDK,JRE,JIT , Bytecode and JVMSimple java program</li> <li>● Data Types Variable: final, static, abstract</li> <li>● Array, Function.</li> </ul>	4



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2	<b>Objects and Classes</b> <ul style="list-style-type: none"> <li>● Definition of Class</li> <li>● Access Specifiers, Constructors Use of “this” keyword</li> <li>● String, String Buffer, and Wrapper class</li> <li>● Inner classes, Nested classes, local classes, Anonymous classes (Anonymous object) Introduction to Packages</li> <li>● Garbage Collection (finalize () Method)</li> </ul>	8
3	<b>Inheritance and Collection</b> <ul style="list-style-type: none"> <li>● Inheritance Basics, Types of Inheritance, Use of 'super' and 'Final' Keyword</li> <li>● Usage of abstract class and abstract methods Interface.</li> <li>● Introduction to Collection</li> </ul>	8
4	<b>Exception Handling and I/O</b> <ul style="list-style-type: none"> <li>● Introduction to Exception handling Exception types , Exception class</li> <li>● User defined exception</li> <li>● Introduction to Java.io package Byte streams,</li> <li>● Character streams File IO basics</li> <li>● Object serialization – Reader and Writer</li> </ul>	6
5	<b>Swing, Applet programming</b> <ul style="list-style-type: none"> <li>● VC(Model View Controller) Architecture Swing</li> <li>● Applet fundamentals, Applet life cycle, Creating and running applets</li> <li>● Applets: Event Handling using applets</li> </ul>	12
6	<b>Database Programming</b> <ul style="list-style-type: none"> <li>● Introduction to JDBC: Architecture</li> <li>● JDBC Drivers , Connectivity . JDBC statement,</li> <li>● JDBC Result Set and types</li> <li>● JDBC Metadata</li> </ul>	8
7	<b>Servlets</b> <ul style="list-style-type: none"> <li>● Introduction to Servlet and Hierarchy of Servlet Life cycle of servlet</li> <li>● Handling HTTP Request and HTTP Response</li> <li>● Http Servlet: Reading form data from servlet</li> <li>● Servlet – Database communication</li> </ul>	8

**M.Sc. (Computer Applications)**

	<ul style="list-style-type: none"> <li>● Session tracking –User Authorization, URL Rewriting, Hidden Form fields,Cookies and Http Session</li> </ul>	
8	<b>JSP</b> <ul style="list-style-type: none"> <li>● Simple first JSP programLife cycle of JSP</li> <li>● Implicit Objects</li> <li>● Scripting elements –Declarations, Expressions, Scriptlets, Comments JSP Directives –Page Directive, include directive</li> <li>● Mixing Scriptlets and HTML</li> <li>● Example of forwarding contents from database to servlet , servlet to JSP and displaying it using JSP scriptlet tag</li> </ul>	6

**References:**

<b>Sr. No.</b>	<b>Title of the Book</b>	<b>Author/s</b>	<b>Publication</b>
1	Complete reference Java	Herbert Schildt	McGraw Hill Education; 4th ed
2	Java 2 programming black books	Steven Horlzner	
3	Java EE Project using EJB 3, JPA and struts 2 for beginners	Shah	SPD
4	Core Java Volume-II Advanced Features, Eighth Edition	Cay S.Horstmann, Gary Cornell	Prentice Hall, Sun Microsystems Press
5	Commercial web development using java 2.0	Ivan Byaross	BPB
6	Java Programming A practical Approach	C Xavier	McGraw Hill

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- I Semester- II		
<b>Course Code:</b> COMCA52102	<b>Course Name: Data Warehousing &amp; Data Mining</b>	<b>Total Lectures (60 Hours)</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>Databases, Programming Languages</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>To Prepare student to think about programming languages analytically to</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>Learn data pre-processing and its importance</li> <li>Understand basic data mining and warehousing tasks</li> <li>Apply clustering and association rule algorithms to databases</li> </ul>	
Chapter	Course Contents	No. of Lectures
1	<b>Introduction to Data Mining.</b> <ul style="list-style-type: none"> <li>Basic Data Mining Tasks.</li> <li>DM versus Knowledge Discovery in Databases.</li> <li>Data Mining Issues.</li> <li>Overview of Applications of Data Mining.</li> </ul>	4
2	<b>Introduction to Data Warehousing.</b> <ul style="list-style-type: none"> <li>Architecture of DW</li> <li>OLAP and Data Cubes</li> <li>Dimensional Data Modeling-star, snowflake schemas</li> <li>Data Preprocessing – Need, Data Cleaning, Data Integration &amp; Transformation, Data Reduction</li> <li>Machine Learning</li> </ul>	8
3	<b>Data Mining Tasks</b> <ul style="list-style-type: none"> <li>Frequent item-sets and Association rule mining: Apriori algorithm,</li> <li>Use of sampling for frequent item-set, FP tree algorithm</li> <li>Graph Mining: Frequent subgraph mining, Tree mining, Sequence Mining.</li> </ul>	12
4	<b>Classification And Prediction</b> <ul style="list-style-type: none"> <li>Decision tree learning Construction, performance, attribute selection</li> <li>Issues: Over-fitting, tree pruning methods, missing values, continuous classes Classification and Regression Trees (CART)</li> <li>Bayesian Classification: Bayes Theorem, Naïve Bayes classifier,</li> </ul>	16

**M.Sc. (Computer Applications)**

	<ul style="list-style-type: none"> <li>● Bayesian Networks Inference</li> <li>● Parameter and structure learning <ul style="list-style-type: none"> <li>○ Linear classifiers.</li> <li>○ Least squares, logistic, perceptron and SVM classifiers</li> </ul> </li> <li>● Prediction <ul style="list-style-type: none"> <li>○ Linear regression</li> <li>○ Non-linear regression</li> </ul> </li> </ul>	
5	<b>Accuracy Measures</b> <ul style="list-style-type: none"> <li>● Precision, recall, F-measure</li> <li>● confusion matrix, cross-validation, bootstrap</li> </ul>	4
6	<b>Clustering</b> <ul style="list-style-type: none"> <li>● k-means</li> <li>● Expectation Maximization (EM) algorithm</li> <li>● Hierarchical clustering, Correlation clustering</li> </ul>	12
7	<b>Software for data mining and applications of data mining</b> <ul style="list-style-type: none"> <li>● R &amp; Weka Tool</li> </ul>	4

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Data Mining: Concepts and Techniques,, ISBN:9789380931913	Han & Kamber	Elsevier
2	Data Mining – Introductory and Advanced Topics	Margaret H. Dunham, S. Sridhar	Pearson Education
3	Machine Learningl	Tom Mitchell	McGraw-Hill,
4	Pattern Recognition and Machine Learningl	Christopher M. Bishop	Springer
5	Database Management Systems	Raghu Ramkrishnan, Johannes Gehrke	
6	Eibe Frank Data Mining: Practical Machine Learning Tools and Techniques	Ian H.Witten	Tata McGraw Hill
7	Data Mining & Data Science	Dr. Dipali Meher Dr Pallawi Bulakh	Nirali Publications

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- I Semester- II		
<b>Course Code:</b> COMCA52103	<b>Course Name:</b> Computer Networks	<b>Total Lectures</b> (60 Hours)
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Fundamentals of Computers</li> <li>● Basics of internet/ ICT</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Learning about computer network organization and implementation,</li> <li>● obtaining a theoretical understanding of data communication and computer networks,</li> <li>● gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Understand the concepts of Data Communication.</li> <li>● Understand the functions of OSI Layers.</li> <li>● Familiarise with the Transmission Media, Flow Control and Error Detection &amp; Correction.</li> </ul>	
Chapter	Course Contents	No. of Lectures
1	<b>Introduction to Computer Networks</b> <ul style="list-style-type: none"> <li>● Characteristics of data communication, components, data representation, dataflow.</li> <li>● Distributed processing, Physical Structure-Point to Point, Broadcast,</li> <li>● Categories of topology (mesh, star, ring, bus )</li> <li>● LAN, WAN, MAN, INTERNET etc.</li> <li>● Definition of protocol, key elements,</li> <li>● Protocols, peers, interfaces, network architecture, protocol stack.</li> <li>● design issues of the layers – addressing, error control, flow control, multiplexing and demultiplexing, routing Connection-oriented and connectionless service.</li> <li>● Service Primitives – listen, connect, receive, send, disconnect The Relationships of services to protocol</li> </ul>	8
2.	<b>Network Models</b> <ul style="list-style-type: none"> <li>● OSI Reference model functionality of each layer TCP/IP model</li> <li>● Introduction to IP, TCP &amp; UDP TCP/IP Protocol Suite</li> <li>● Addressing- Physical, Logical &amp; Port addresses</li> </ul>	4

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3.	<p><b>The Physical Layer</b></p> <ul style="list-style-type: none"> <li>● The Basic Concepts of analog &amp; digital signals</li> <li>● Bit rate, bit length, baseband transmission Transmission Impairments – attenuation, distortion, and noise Data Rate Limits – Nyquist’s bit rate formula for noiseless channel and Shannon’s law Problems on above concepts Performance of the Network</li> <li>● Bandwidth, Throughput, Latency (Delay),</li> <li>● Bandwidth –Delay Product, Jitter Problems ob above concepts</li> <li>● Line Coding digital to digital conversion Characteristics, Line Coding Schemes Unipolar, NRZ, RZ, Manchester andDifferential Manchester</li> <li>● Transmission Modes -Parallel Transmission Serial Transmission – Asynchronous and Synchronous</li> <li>● Multiplexing- FDM, TDM, WDM.</li> <li>● Switching -Circuit Switching, Message Switching and Packet Switching</li> </ul>	8
	<p><b>The Data Link Layer</b></p> <ul style="list-style-type: none"> <li>● Framing -Character Count, Byte Stuffing,</li> <li>● Bit Stuffing and Physical Layer Coding Violations</li> <li>● Error Control - Hamming Code and CRC</li> <li>● Elementary data link protocols - Simplex stop &amp; wait protocol, Simplex protocol for noisy channels.</li> <li>● Sliding Window Protocols - 1-bit sliding window protocols, Pipelining – Go-Back N and Selective Repeat</li> </ul>	8
5.	<p><b>The Medium Access Sub layer</b></p> <ul style="list-style-type: none"> <li>● Random Access Protocols ALOHApure and slotted, CSMA – 1-persistent, p persistent andNon-persistent CSMA/CD, CSMA/CA</li> <li>● Controlled Access- Reservation, Polling and Token Passing</li> <li>● Channelization - FDMA, TDMA and CDMA</li> </ul>	8
6.	<p><b>The Network layer</b></p> <ul style="list-style-type: none"> <li>● Design Issues</li> <li>● Store-and-forward packet switching, Services Provided to the Transport Layer,Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram</li> <li>● Logical Addressing</li> <li>● IPV4 Addresses – Address Space, Notations, Classful Addressing, ClasslessAddressing, Network Address Translation (NAT) IPV6</li> </ul>	8

**M.Sc. (Computer Applications)**

	<p>Addresses – Addressing Structure, Address Space</p> <p>5. IPV4 Protocol - Datagram Format, Fragmentation, Checksum, Options</p> <ul style="list-style-type: none"> <li>● IPV6 Protocol -Advantages, Packet Format, Extension Headers</li> <li>● Transition From IPV4 to IPV6 - Dual Stack, Tunneling, Header Translation</li> <li>● Routing Concepts - Properties of routing algorithm, Comparison of Adaptive and Non-Adaptive Routing Algorithms.</li> </ul>	
7.	<p><b>The Transport layer</b></p> <ul style="list-style-type: none"> <li>● Process-to-Process Delivery</li> <li>● Client Server Paradigm, Multiplexing and Demultiplexing, Connectionless Vs Connection-Oriented Service, Reliable Vs Unreliable</li> <li>● User Datagram Protocol UDP</li> <li>● Datagram Format, Checksum, UDP operations, Use of UDP</li> <li>● Transmission Control Protocol (TCP)</li> <li>● TCP Services, TCP Features, TCP Segment, TCP Connection, Flow Control, Error Control TCP Congestion Control Slow Start Mechanism</li> </ul>	8
8.	<p><b>The Application layer</b></p> <ul style="list-style-type: none"> <li>● Domain Name System (DNS) - Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Name – Address Resolution</li> <li>● TELNET- Time Sharing Environment, Logging, NVT, Embedding, Options, Mode of Operations</li> <li>● E-MAIL - Architecture, User Agent, Message Transfer Agent-SMTP, Message Access Agent-POP, IMAP, Web Based Mail</li> <li>● File Transfer Protocol (FTP) - Communication over control connection, Communication over Data Connection, Anonymous FTP</li> <li>● WWW -Architecture, WEB Documents</li> <li>● HTTP - HTTP Transaction, Persistent and Non-persistent Connection, Proxy Server</li> </ul>	8

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Computer Networks	A. Tanenbaum,	Pearson
2	Data Communication and Networking	Behrouz Forouzan	TATA McGrawHill.Fourth

			edition
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Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- II Semester- III		
<b>Course Code:</b> COMCA52104	<b>Course Name:</b> Principles of Product Management	<b>Total Lectures</b> (30 Hours)
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> IA: 20 Marks CE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Basic understanding of technology and the development process</li> <li>● Being able to conduct market research, gather customer insights, and analyze data</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Understanding of business principles and strategy</li> <li>● Understand the role of Product Manager</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Think long-term and set a clear vision for the product's future.</li> <li>● Learn about Product managers and their work with cross-functional teams, leadership and teamwork skills.</li> <li>● Learn about listening actively to customer feedback.</li> <li>● Think about their product plans with the company's overall goals and strategies.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Product Management</b> <ul style="list-style-type: none"> <li>● What is product management?</li> <li>● The role of a product manager</li> <li>● The product life cycle</li> <li>● Key skills and qualities of a successful product manager.</li> </ul>	5
2	<b>Market Research and Analysis</b> <ul style="list-style-type: none"> <li>● Customer segmentation and personas.</li> <li>● Market trends and competitive analysis.</li> <li>● Conducting surveys, interviews, and usability testing.</li> </ul>	4
3	<b>Product Strategy</b> <ul style="list-style-type: none"> <li>● Defining the product vision and mission.</li> <li>● Setting product goals and objectives.</li> <li>● Creating a product roadmap.</li> </ul>	4
4	<b>Ideation and Concept Development</b> <ul style="list-style-type: none"> <li>● Generating and evaluating product ideas</li> <li>● Prioritizing features and concepts</li> <li>● Building a business case</li> </ul>	4
5	<b>Product Development and Lifecycle</b> <ul style="list-style-type: none"> <li>● Agile and Scrum methodologies.</li> </ul>	3



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	<ul style="list-style-type: none"> <li>● Minimum Viable Product (MVP) concept.</li> </ul>	
6	<b>Product Strategy</b> <ul style="list-style-type: none"> <li>● Setting product goals and objectives.</li> <li>● Creating a product roadmap.</li> <li>● Defining the value proposition.</li> <li>● Pricing and monetization strategies.</li> </ul>	2
7	<b>User Experience (UX) and Design</b> <ul style="list-style-type: none"> <li>● User interface (UI) design</li> <li>● User testing and feedback</li> </ul>	2
8	<b>Agile and Scrum Methodologies</b> <ul style="list-style-type: none"> <li>● Introduction to Agile and Scrum.</li> <li>● Agile project management tools</li> </ul>	3
9	<b>Product Development and Engineering</b> <ul style="list-style-type: none"> <li>● Working with development teams</li> <li>● Agile project management</li> </ul>	3

**References**

Sr. No.	Title of the Book	Author/s	Publication
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 Applications) Year- I Semester- II		
<b>Course Code:</b> COMCA52201	<b>Course Name: Project</b>	<b>Total Lectures (30 Hours)</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● OOSE concepts</li> <li>● Knowledge of Programming languages, software Tools and techniques</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Development of application software</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Undertake problem identification, formulation and solution for any software project.</li> <li>● Design computer science solutions to complex problems utilizing a systems approach.</li> <li>● Prepare students to work as part of teams on multi-disciplinary projects.</li> </ul>	
<b>Guidelines</b>	Project can be done on any platform and independent of any language.	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction</b> <ul style="list-style-type: none"> <li>● Motivation</li> <li>● Problem statement</li> <li>● Purpose/objective and goals</li> <li>● Literature /Survey</li> <li>● Project scope and limitations</li> </ul>	2

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2	<b>System Analysis</b> <ul style="list-style-type: none"> <li>● Existing systems</li> <li>● Scope and limitations of existing systems</li> <li>● Project perspective, features</li> <li>● Stakeholders</li> <li>● Requirement analysis</li> <li>● Functional requirements, performance requirements, security requirements etc.</li> </ul>	3
3	<b>System design</b> <ul style="list-style-type: none"> <li>● Design constraints</li> <li>● System Model: UML diagrams</li> <li>● Data Model</li> <li>● User interfaces</li> </ul>	6
4	<b>Implementation Details</b> <ul style="list-style-type: none"> <li>● Software/hardware specifications</li> </ul>	8
5	<b>Outputs and Reports</b>	5
6	<b>Testing</b> <ul style="list-style-type: none"> <li>● Test Plan, Black Box Testing or Data Validation Test Cases, White Box Testing or Functional Validation Test cases and results</li> </ul>	3
7	<b>Conclusion and Recommendations Future Scope</b>	2
8	<b>Bibliography and References</b>	1
9	●	

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1.	Software Engineering	Roger Pressman	McGraw-Hill
2.	Software Metrics for Project Management and process improvement	Robert B. Grady	Prentice hill

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- I Semester- II		
<b>Course Code:COMCA52202</b>	<b>Course Name: Project Related Assignments</b>	<b>Total Lectures (30 Hours)</b>
<b>Teaching Scheme: 4 hrs/week</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>	<b>No. of Credits: 2</b>
<b>Course Prerequisites:</b>	Student should have basic knowledge of: <ul style="list-style-type: none"> <li>• OOSE concepts</li> <li>• Knowledge of Programming languages, software Tools and techniques</li> </ul>	
<b>Course Objectives:</b>	To Prepare student to think about programming languages analytically to <ul style="list-style-type: none"> <li>• Development of application software</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>• Undertake problem identification, formulation and solution for any software project.</li> <li>• Design computer science solutions to complex problems utilizing a systems approach.</li> <li>• Prepare students to work as part of teams on multi-disciplinary projects</li> </ul>	
<b>Guidelines</b>	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. Each student within the group must work actively and contribute to the assignments, project work and report writing.	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	Project Time management: plan (schedule table), Gantt chart, Roles and responsibilities, data collection, Implementation	2
2	Simple assignments to evaluate choice of technology	3
3	Assignments on UI elements in chosen technology	4
4	Assignments on User interfaces in the project	8
5	Assignments on event handling in chosen technology	5
6	Assignments on Data handling in chosen technology	3

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7	Online and offline connectivity	<b>2</b>
8	Report generation	<b>1</b>
9	Deployment considerations	<b>1</b>
10	Test cases	<b>1</b>

**References:**

<b>Sr. No.</b>	<b>Title of the Book</b>	<b>Author/s</b>	<b>Publication</b>
1.	Software Engineering	Roger Pressman	McGraw-Hill
2.	Software Metrics for Project Management and process improvement	Robert B. Grady	Prentice hill

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -II Semester- III		
<b>Course Code:</b> COMCA63101	<b>Course Name: Mobile Application Development Using Android</b>	<b>Total Lectures (60 Hours)</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Knowledge of JAVA programming language and OOP concept.</li> <li>● Familiar with the network Protocol stack</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Gain knowledge about different mobile platform and application development</li> <li>● To know the programming using Android on IOS and Windows platform to develop the mobile app.</li> </ul>	
<b>Course Outcomes:</b>	<ul style="list-style-type: none"> <li>● Develop mobile applications using GUI and Layouts.</li> <li>● Develop mobile applications using Event Listener. Develop mobile applications using Databases</li> <li>● Analyse and discover own mobile app for simple needs.</li> </ul>	
<b>Chapter</b>		<b>No. of Lectures</b>
1	<b>Android Fundamentals</b> <ul style="list-style-type: none"> <li>● Introduction to Android - Overview and evolution of Android ,</li> <li>● Features of Android, Android architecture</li> <li>● Components of an Android Application, Manifest file</li> <li>● Android ActivityService Lifecycle</li> </ul>	7
2	<b>Android UI Design</b> <ul style="list-style-type: none"> <li>● Basic UI Designing (Form widgets ,Text Fields , Layouts</li> </ul>	10

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	<p>,[dip, dp, sip, sp] versus px)</p> <ul style="list-style-type: none"> <li>● Intent(in detail)</li> <li>● All components (e.g Button , Slider, Image view, Toast) Event Handling</li> <li>● Adapters and Widgets</li> <li>● Menu</li> </ul>	
3	<p><b>Threads running on UI thread (runOnUiThread)</b></p> <ul style="list-style-type: none"> <li>● Worker thread</li> <li>● Handlers &amp; Runnable</li> <li>● Asyn Task (in detail)</li> <li>● Broadcast Receivers</li> <li>● Services and notifications</li> <li>● Toast</li> <li>● Alarms</li> </ul>	10
4	<p><b>Advanced Android Programming</b></p> <ul style="list-style-type: none"> <li>● Content Providers – SQLite Programming</li> <li>● JSON Parsing</li> <li>● Accessing Phone Service(Call, SMS, MMS)</li> <li>● Location based services</li> </ul>	8
5	<p><b>PhoneGap Programming</b></p> <ul style="list-style-type: none"> <li>● Why Use PhoneGap?</li> <li>● How PhoneGap Works</li> <li>● Designing for the Container</li> <li>● Writing PhoneGap Applications</li> <li>● Building PhoneGap Applications</li> <li>● PhoneGap Limitations</li> <li>● PhoneGap Plug-Ins</li> <li>● Hello, World! Program</li> <li>● PhoneGap APIs –1</li> </ul>	8
6	<p><b>iOS Fundamentals</b></p> <ul style="list-style-type: none"> <li>● Introduction - What is IOS ,IOS Architecture, Frameworks, Application Life Cycle, Features</li> </ul>	8

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	<ul style="list-style-type: none"> <li>● Swift - Introduction to Swift ,General Concepts of Swift</li> <li>● Xcode - Introduction to Xcode , Navigator, Editor Utility, Tools, Console, Document, Simulator, Instruments</li> <li>● Startup - Application Templates, Introduction to Storyboard , Hello World Application, How 'Hello World' Working, Debugging Database, Plist, Preference, Sqlite Web Service, Restful Web Service (JSON &amp; XML)</li> </ul>	
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**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	IOS Apprentice	Matthijs Hollemans	
2	PhoneGap: Beginner's Guide	Giorgio Natili, Purusothaman Ramanujam	PACKT Publicatio n
3	Beginning Android Application Development	Evan You Wei-Meng Lee Wiley	



Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -II Semester- III		
<b>Course Code:</b> COMCA63102	<b>Course Name:</b> Software Testing Tools	<b>Total Lectures</b> (60 Hours)
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Basic knowledge of test cases, planning and expected inputs/output</li> <li>● Knowledge of manual and automated testing tools</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To provide the knowledge of software testing methods and strategies.</li> <li>● To understand how testing methods can be used as an effective tool in quality assurance of software.</li> <li>● To provide skills to design test case plan for testing software.</li> <li>● To provide knowledge of latest testing tools</li> </ul>	
<b>Course Outcomes:</b>	<ul style="list-style-type: none"> <li>● To understand various software testing methods and strategies.</li> <li>● To understand a variety of software metrics and identify defects and managing those defects for improvement in quality for given software.</li> <li>● To design test cases and test plans, review reports of testing for qualitative software.</li> <li>● To understand latest testing tools used in the software industries.</li> </ul>	
<b>Chapter</b>		<b>No. of Lectures</b>
1	<b>Introduction to Test case design</b> <ul style="list-style-type: none"> <li>● How to identify errors, bugs in the given application.</li> <li>● Design entry and exit criteria for test case, design test cases in excel.</li> <li>● Describe features of a testing method used.</li> </ul>	6
2	<b>Software Testing Life Cycle</b> <ul style="list-style-type: none"> <li>● Overview of the stages of STLC:</li> <li>● Test planning</li> <li>● Test design</li> <li>● Test execution</li> <li>● Test Plan walkthrough - Live Project document</li> <li>● Practical tips on how to identify the following items for the Test plan: <ul style="list-style-type: none"> <li>o Scope</li> </ul> </li> </ul>	9

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	<ul style="list-style-type: none"> <li>o Test strategy</li> <li>o Effort Estimation</li> <li>o Entry criteria o Exit Criteria</li> <li>o Defect Management process</li> </ul>	
3.	<b>Test Templates creation and use</b> <ul style="list-style-type: none"> <li>● Test scenario template</li> <li>● Test case template</li> <li>● Test plan Defect report Status report...etc</li> <li>● Test scenario creation – what are they, how to write them, why, when etc.</li> <li>● Test documentation review- How to perform Peer reviews</li> <li>● Test cases creation</li> <li>● Test case design techniques <ul style="list-style-type: none"> <li>o Boundary Value analysis</li> <li>o Equivalence partitioning</li> <li>o Error guessing o Types of parameters</li> </ul> </li> </ul>	10
4	<b>Test cases and Test plan</b> <ul style="list-style-type: none"> <li>● Write Test Plan for given application with resources required. Write Test case for given application.</li> <li>● Prepare Test report for test cases executed.</li> <li>● Write simple programs make use of loops and control structures. Write test Cases for above programs.</li> </ul>	12
5	<b>Defect Report</b> <ul style="list-style-type: none"> <li>● Defect Life Cycle</li> <li>● Classification of Defect</li> <li>● Write Defect Report</li> </ul>	6
6	<b>Testing Tools</b> <ul style="list-style-type: none"> <li>● How to make use of Automation Tools</li> <li>● Types of Testing Tools</li> </ul>	5
7	<b>Java Programming for Selenium</b> <ul style="list-style-type: none"> <li>● Introduction to Java Programming</li> <li>● Java Environment Setup</li> <li>● Java Keywords and Identifiers</li> <li>● Java Basic Syntax and Program Structure.</li> <li>● Comments and Modifiers in Java</li> <li>● Modifiers in Java.</li> <li>● Java Data Types, Variables and Operators in Java</li> <li>● Java Control Flow Statements.</li> <li>● Java Strings and Numbers</li> <li>● Java Arrays</li> </ul>	12

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Software Testing	Ron Patton	
2	Effective Methods of Software Testing	William E. Perry	

**M.Sc. (Computer Applications)**

3	Managing the Testing Process: Practical Tools and Techniques for Managing Hardware and Software Testing, R	Rex Black	
4	Software Testing Principles and Practices	Srinivasan Desikan	

<b>Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016</b> <b>M.Sc. (Computer Applications) Year -II Semester- III</b>		
<b>Course Code:</b> COMCA63103	<b>Course Name:</b> Data Science	<b>Total Lectures (60 Hours)</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Problem solving using computers</li> <li>● Basic mathematics and statistics</li> <li>● Knowledge of Databases</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Provide students with knowledge and skills for data-intensive problem solving and scientific discovery</li> <li>● 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.</li> <li>● Acquire good understanding of both the theory and application of applied statistics and computer science based existing data science models to analyze huge data sets originating from diversified application areas.</li> <li>● Be better trained professionals to cater the growing demand for data scientists in industry</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>● Perform Exploratory Data Analysis</li> <li>● Obtain, clean/process, and transform data.</li> <li>● Detect and diagnose common data issues, such as missing values, special values, outliers, inconsistencies, and localization.</li> <li>● Demonstrate proficiency with statistical analysis of data.</li> <li>● Present results using data visualization techniques.</li> <li>● Prepare data for use with a variety of statistical methods and models and recognize how the quality of the data and the means of data collection may affect conclusions.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction &amp; What is Data Science?</b> <ul style="list-style-type: none"> <li>● Historical Overview of data analysis</li> <li>● Data Scientist vs. Data Engineer vs. Business Analyst,</li> </ul>	5

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	<ul style="list-style-type: none"> <li>● Career in Data Science</li> <li>● Why Data Science</li> <li>● Applications for data science, Data Scientists Roles and Responsibility</li> </ul>	
2	<b>Data</b> <ul style="list-style-type: none"> <li>● Data Collection</li> <li>● Data Management</li> <li>● Big Data Management</li> <li>● Organization/sources of data</li> <li>● Importance of data quality</li> <li>● Dealing with missing or incomplete data</li> </ul>	5
3	<b>Data Classification Data Science Project Life Cycle</b> <ul style="list-style-type: none"> <li>● Business Requirement</li> <li>● Data Acquisition</li> <li>● Data Preparation</li> <li>● Hypothesis and Modeling</li> <li>● Evaluation and Interpretation, Deployment.</li> </ul>	5
4	<b>Introduction to Data Mining</b> <ul style="list-style-type: none"> <li>● The origins of Data Mining</li> <li>● Data Mining Tasks</li> <li>● OLAP and Multidimensional data analysis</li> <li>● Basic concept of Association Analysis and Cluster Analysis</li> </ul>	5
5	<b>Introduction to Machine Learning</b> <ul style="list-style-type: none"> <li>● History and Evolution</li> <li>● AI Evolution</li> <li>● Statistics Vs Data Mining Vs, Data Analytics Vs, Data Science</li> <li>● Supervised Learning</li> <li>● Unsupervised Learning</li> <li>● Reinforcement Learning</li> <li>● Frameworks for building Machine Learning Systems.</li> </ul>	5
6	<b>Application of Business Analysis</b> <ul style="list-style-type: none"> <li>● Retail Analytics</li> <li>● Marketing Analytics</li> <li>● Financial Analytics</li> <li>● Healthcare Analytics</li> <li>● Supply Chain Analytics.</li> </ul>	5

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Bhimasankaram Pochiraju, SridharSeshadri,	Essentials of Business Analytics: An Introduction to the methodology and its application,	Springer

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2	Andreas C. Müller, Sarah Guido	Introduction to Machine Learning with Python: A Guide for Data Scientists	O'Reilly
3	Laura Igual Santi Seguí,	Introduction to Data Science	Springer
4	Pang-Ning Tan, Michael Steinbach, Vipin Kumar,	Introduction to Data Mining,	Pearson Education India

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -II Semester- III		
<b>Course Code:</b> COMCA63104	<b>Course Name:</b> Practical on Data Science	<b>Total Practicals:</b> (30 Hours)
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> IA: 20 Marks CE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites</b>	<ul style="list-style-type: none"> <li>● Problem solving using computers</li> <li>● Basic mathematics and statistics</li> <li>● Knowledge of Databases</li> <li>● Basic knowledge of Python</li> </ul>	
<b>Assignment No</b>	<b>Assignment</b>	<b>No. of Sessions</b>
1	Data Pre-processing Write a python program to find all null values in a given data set and remove them. (Download dataset from github.com)	1
2	Write a python program to implement complete data pre-processing in a given data set.(missing value, encoding categorical value, Splitting the dataset into the training and test sets and feature scaling.(Download dataset from github.com).	1
3	Classification Write a Python program build Decision Tree Classifier using Scikit-learn package for diabetes data set (download database from <a href="https://www.kaggle.com/uciml/pima-indians-diabetes-database">https://www.kaggle.com/uciml/pima-indians-diabetes-database</a> )	1
4	Consider following dataset weather=['Sunny','Sunny','Overcast','Rainy','Rainy','Rainy','Overcast','Sunny','Sunny','Rainy','Sunny','Overcast','Overcast','Rainy'] temp=['Hot','Hot','Hot','Mild','Cool','Cool','Cool','Mild','Cool','Mild','Mild','Hot','Mild'] play=['No','No','Yes','Yes','Yes','No','Yes','No','Yes','Yes','Yes','Y	1

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	es','Y es','No']. Use Naïve Bayes algorithm to predict[ 0:Overcast, 2:Mild] tuple belongs to which class whether to play the sports or not.	
<b>5</b>	Association Rules Write a Python Programme to read the dataset (“Iris.csv”). dataset download from ( <a href="https://archive.ics.uci.edu/ml/datasets/iris">https://archive.ics.uci.edu/ml/datasets/iris</a> ) and apply Apriori algorithm.	1
<b>6</b>	Write a Python program to read “StudentsPerformance.csv” file. Solve following: - To display the shape of dataset. - To display the top rows of the dataset with their columns. - To display the number of rows randomly. - To display the number of columns and names of the columns. Note: Download dataset from following link :  ( <a href="https://www.kaggle.com/spscientist/students-performance-in-exams?select=StudentsPerformance.csv">https://www.kaggle.com/spscientist/students-performance-in-exams?select=StudentsPerformance.csv</a> )	1
<b>7</b>	Regression Analysis and Outlier Detection Consider following observations/data. And apply simple linear regression and find out estimated coefficients b1 and b1 Also analyse the performance of the model (Use sklearn package) x = np.array([1,2,3,4,5,6,7,8]) y = np.array([7,14,15,18,19,21,26,23])	1
<b>8</b>	Write a python program to implement multiple Linear Regression model for a car dataset. Dataset can be downloaded from: <a href="https://www.w3schools.com/python/python_ml_multiple_regression.asp">https://www.w3schools.com/python/python_ml_multiple_regression.asp</a>	1
<b>9</b>	Write a python program to implement k-means algorithm to build prediction model (Use Credit Card Dataset CC GENERAL.csv Download from kaggle.com)	1
<b>10</b>	Write a python program to implement hierarchical clustering algorithm. (Download Wholesale customers data dataset from github.com).	1

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Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -II Semester- III		
<b>Course Code:</b> COMCA63103	<b>Course Name:</b> Python Programming	<b>Total Lectures (30 Hours)</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<ul style="list-style-type: none"> <li>● Problem solving using computers</li> <li>● Basic mathematics and statistics</li> <li>● Knowledge of Databases</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To introduce various concepts of programming to the students using Python.</li> <li>● Students should be able to apply the problem solving skills using Python</li> </ul>	
<b>Course Outcomes:</b>	After successful completion of course students will be able to: <ul style="list-style-type: none"> <li>● Express proficiency in the handling of strings and functions.</li> <li>● Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.</li> <li>● Identify the commonly used operations involving file systems and regular expressions.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Python</b> <ul style="list-style-type: none"> <li>● Why Scripting is Useful in Computational Science</li> <li>● Why Python? Script or Program?</li> <li>● Application of Python</li> <li>● Python identifiers and reserved words</li> <li>● Lines and indentation, multi-line statements and Comments</li> <li>● Input/output with print and input functions,</li> <li>● Command line arguments and processing command linear arguments</li> <li>● Standard data types - basic, none, Boolean (true &amp; False), numbers</li> <li>● Data type conversion</li> <li>● Python basic operators (Arithmetic, comparison, assignment, bitwise logical)</li> <li>● Python membership operators (in &amp; not in)</li> <li>● Python identity operators (is &amp; is not)</li> </ul>	4



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	<ul style="list-style-type: none"> <li>● Operator precedence</li> <li>● Control Statements, Python loops, Iterating by subsequence index, loop</li> <li>● control statements, Menu Driven Implementation (break, continue, pass)</li> </ul>	
2	<b>Python Strings</b> <ul style="list-style-type: none"> <li>● Concept, escape characters</li> <li>● String special operations</li> <li>● String formatting operator</li> <li>● Single quotes, Double quotes, Triple quotes</li> <li>● Raw String, Unicode strings, Built-in String methods</li> <li>● Python Lists - concept, creating and accessing elements, updating &amp; deleting</li> <li>● lists, basic list operations, reverse</li> <li>● Indexing, slicing and Matrices</li> <li>● built-in List functions</li> <li>● Functional programming tools – filter (), map(), and reduce()</li> <li>● Using Lists as stacks and Queues, List comprehensions</li> </ul>	5
3	<b>Python tuples, sets, Dictionary</b> <ul style="list-style-type: none"> <li>● Creating &amp; deleting tuples, Updating tuples</li> <li>● Accessing values in a tuple, deleting tuple elements</li> <li>● built- in tuple functions and operations</li> <li>● Indexing, slicing and Matrices</li> <li>● Sets - Concept, operations.</li> <li>● Dictionary Concept (mutable)</li> <li>● Creating and accessing values in a dictionary</li> <li>● Updating dictionary, delete dictionary elements</li> <li>● Properties of dictionary keys</li> <li>● built-in dictionary functions and methods.</li> </ul>	5
4	<b>Functions</b> <ul style="list-style-type: none"> <li>● Defining a function (def) and calling a function</li> <li>● Function arguments - Pass by value, Keyword Arguments, default arguments</li> <li>● Scope of variable - basic rules</li> <li>● Documentation Strings</li> <li>● Variable Number of Arguments</li> <li>● Call by Reference</li> <li>● Order of arguments (positional, extra &amp; keyword)</li> <li>● Anonymous functions</li> <li>● Recursion</li> <li>● Treatment of Input and Output Arguments</li> <li>● Unpacking argument lists</li> <li>● Lambda forms</li> <li>● Function Objects</li> <li>● function ducktyping &amp; polymorphism</li> <li>● Generators (functions and expressions) and iterators</li> </ul>	5

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5	<b>Files &amp; Directories</b> <ul style="list-style-type: none"> <li>● Creating files and Operations on files (open, close, read, write)</li> <li>● File object attributes, file positions, Listing Files in a Directory</li> <li>● Testing File Types</li> <li>● Removing Files and Directories</li> <li>● Copying and Renaming Files</li> <li>● Splitting Pathnames</li> <li>● Creating and Moving to Directories</li> <li>● Traversing Directory Trees</li> <li>● Illustrative programs: word count, copy file</li> </ul>	5
6	<b>Python Classes and Objects</b> <ul style="list-style-type: none"> <li>● Object oriented programming and classes in Python</li> <li>● creating classes, instance objects, accessing members</li> <li>● Data hiding (the double underscore prefix)</li> <li>● Built-in class attributes</li> <li>● Garbage collection : the constructor</li> <li>● Overloading methods and operators</li> <li>● Inheritance - implementing a subclass, overriding methods</li> <li>● Recursive calls to methods</li> <li>● Class variables, class methods, and static methods</li> </ul>	5
7	<b>Python Exceptions</b> <ul style="list-style-type: none"> <li>● Exception handling : assert statement</li> <li>● Except clause - with no exceptions and multiple exceptions</li> <li>● Try - finally, raising exceptions, user-defined exceptions.</li> </ul>	

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Introducing Python- Modern Computing in Simple Packages	Bill Lubanovic	OReilly Publication
2	Beginning Python:	Novice to Professional, Magnus Lie Hetland, Apress	
3	Practical Programming:An Introduction to Computer Science Using Python	Paul Gries, et al.,Pragmatic Bookshelf, 2/E 2014	
4	Introduction to Computer Science Using Python- ,	Charles Dierbach	Wiley

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			Publication
5	E-Books: python_tutorial. pdf, python_book_01.pdf		
6	Beginning Programming with Python for Dummies Paperback	John PaulMueller	
7	A Beginner's Python Tutorial: <a href="http://en.wikibooks.org/wiki/A_Beginner's_Python_Tutorial">http://en.wikibooks.org/wiki/A Beginner's Python Tutorial.</a>		

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year -II Semester- III		
<b>Course Code:</b> COMCA63202	<b>Course Name:</b> Python Programming Practical	<b>Total Practicals:</b> (30 Hours)
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> IA: 20 Marks CE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites</b>	<ul style="list-style-type: none"> <li>● Problem solving using computers</li> <li>● Basic mathematics and statistics</li> <li>● Knowledge of Databases</li> <li>● Basic knowledge of Python</li> </ul>	
<b>Assignment No</b>	<b>Assignment</b>	<b>No. of Sessions</b>
1	1. Create a program that asks the user to enter their name and their age. Print out a message addressed to them that tells them the year that they will turn 100 years old.	1
2	Write a program to check whether the number is even or odd, print out an appropriate message to the user. Write a program that prints out all the elements of the list that are less than 10.	1
3	Write a program that returns a list that contains only the elements that are common between the lists (without duplicates). Make sure your program works on two lists of different sizes	1
4	To determine whether the number is prime or not.	1
5	Write a program that asks the user how many Fibonacci numbers to generate and then generate them.	1
6	Write a program (using functions!) that asks the user for a long string containing multiple words. Print back to the user the same string, except with the words in backwards order. E.g “ I am Msc student” is :”student Msc am I” Write a program to implement binary search to search the given element using a function. Write a Python program to solve the Fibonacci sequence using recursion.	1
7	Given a .txt file that has a list of a bunch of names, count how many of each name there are in the file, and print out the results to the screen.	1

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<b>8</b>	Write a program that accepts a sentence and calculate the number of uppercase letters and lowercase letters.	1
<b>9</b>	Write a Python function that takes a list and returns a new list with unique elements of the first list.	1
<b>10</b>	Write a Python program to read a file line by line store it into an array.	1
<b>11</b>	Virtual lab assignment: <a href="http://vlabs.iitb.ac.in/vlabs-dev/labs/python-basics/experimentlist.html">http://vlabs.iitb.ac.in/vlabs-dev/labs/python-basics/experimentlist.html</a>	1

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Applications) Year- III Semester- IV		
<b>Course Code:</b> COMCA64102	<b>Course Name:</b> DevOps	<b>Total Lectures:60 Hours</b>
<b>Teaching Scheme:</b> 4 hrs/week	<b>Examination Scheme:</b> CIE: 40 Marks ESE: 60 Marks	<b>No. of Credits:</b> 4
<b>Course Prerequisites:</b>	Student should have basic knowledge of: <ul style="list-style-type: none"> <li>● Windows Operating Systems</li> <li>● Programming Languages like C, CPP, Java</li> <li>● Software Engineering</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To introduce students' basic techniques and concepts of DevOps and Version Control Systems</li> <li>● To improve quality and performance of the applications using version control systems</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Understand the essential characteristics of DevOps</li> <li>● Study the concepts like importance of Continuous Integration and Continuous Delivery, Infrastructure as Code, Test Driven Development, Behaviour Driven Development.</li> <li>● Understand the basics of GIT, its various commands and its installations of GIT and Docker.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to DevOps</b> <ul style="list-style-type: none"> <li>● Define Devops</li> <li>● What is Devops</li> <li>● SDLC models, Lean, ITIL, Agile</li> <li>● Why Devops?</li> <li>● Devops Stakeholders</li> <li>● Devops Goals</li> <li>● Important Terminology</li> <li>● Devops Perspective</li> <li>● Configuration Management</li> <li>● Continuous Integration and Deployment</li> </ul>	25
2	<b>Version Control-GIT</b> <ul style="list-style-type: none"> <li>● Introduction to GIT</li> <li>● What is Git</li> <li>● About Version Control System and Types</li> <li>● Difference between CVCS and DVCS</li> </ul>	10

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	<ul style="list-style-type: none"> <li>● GIT Basics</li> <li>● GIT Command Line</li> </ul>	
3	<b>GIT Installation</b> <ul style="list-style-type: none"> <li>● Installing Git</li> <li>● Installing on Windows</li> <li>● Initial Setup</li> <li>● Git Essentials</li> <li>● Creating Repository</li> <li>● Cloning, Check-in and Committing</li> <li>● Fetch Pull and Remote</li> <li>● Branching</li> </ul>	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 Applications) Year- II Semester- IV		
<b>Course Code:</b> COMCS64103	<b>Course Name: DevOps Practical</b>	<b>Total Practicals:</b> 10
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Windows Operating Systems</li> <li>● Programming Languages like C, CPP, Java</li> <li>● Software Engineering</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To introduce students basic techniques and concepts of DevOps and Version Control Systems</li> <li>● To improve quality and performance of the applications using version control systems</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Understand the essential characteristics of DevOps</li> <li>● Study the concepts like importance of Continuous Integration and Continuous Delivery, Infrastructure as Code, Test Driven Development, Behaviour Driven Development.</li> <li>● Understand the basics of GIT, its various commands and its installations of GIT and Docker.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Sessions</b>
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 href="#">A Practical Guide To Git And GitHub For Windows Users: From Beginner Expert In Easy Step By Exercises &amp; Hub (usermanual.wiki)</a> <a href="#">How to Download &amp; Install GIT Tutorial? - Practical Guide (acte.in)</a>		



Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
<b>Course Code:</b> COMCA64101	<b>Course Name: Business Analytics</b>	<b>Total Lectures:</b> <b>60 Hours</b>
<b>Teaching Scheme:</b> <b>4 hrs/week</b>	<b>Examination Scheme:</b> <b>CIE: 40 Marks</b> <b>ESE: 60 Marks</b>	<b>No. of Credits:</b> <b>4</b>
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Basic Knowledge of Computer</li> </ul>	
<b>Course Objectives:</b>	To Prepare student <ul style="list-style-type: none"> <li>● To achieve and establish vital understanding of big data application in business intelligence.</li> <li>● To institute the concept of systematic transformation of process-oriented data into information of underlying business process.</li> <li>● To exhibit knowledge of data analysis techniques and to apply principles of data sciences integrating enterprise reporting.</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● To identify the importance of data science in business process.</li> <li>● To discuss data integration and modelling techniques.</li> <li>● To examine business intelligence concepts for enterprise reporting.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	<b>Introduction to Business Analytics</b> <ul style="list-style-type: none"> <li>● Business Analyst - The evolving role of the Business Analyst</li> <li>● The BA roadmap: different levels of business analysis</li> <li>● The basic rules of Business &amp; Business Analysis Classical Requirements</li> <li>● Tasks performed by Business Analysts.</li> </ul>	10
2	<b>Descriptive, Predictive and Perspective Analysis</b> <ul style="list-style-type: none"> <li>● Data Visualization &amp; Exploration Techniques</li> <li>● Data Summarization &amp; Descriptive Statistics</li> <li>● Time Series Analysis</li> <li>● Optimization Techniques and linear Programming</li> <li>● Decision Analysis and Decision tree</li> <li>● Simulation Modelling and analysis</li> </ul>	12

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3	<b>Big Data Analytics</b> <ul style="list-style-type: none"> <li>● Introduction to Big Data and Challenges</li> <li>● Technologies for Handling Big Data (e.g., Hadoop and Spark)</li> <li>● Data Management and storage solutions for Big Data</li> <li>● Case studies and real-world applications of business analytics</li> </ul>	10
4	<b>Business Intelligence</b> <ul style="list-style-type: none"> <li>● Business Intelligence – Evolution of BI and Role of DSS, EIS, MIS and Digital Dashboards</li> <li>● Need for BI- BI value chain Introduction to Business Analytics.</li> <li>● BI Definitions and Concepts –BI Component Framework – Need for BI –</li> <li>● Introduction to popular business intelligence tools (e.g., Tableau, Power BI)</li> </ul>	10
5	<b>Advanced Topics in Business Analytics</b> <ul style="list-style-type: none"> <li>● <b>Advanced machine learning techniques (e.g., neural networks, support vector machines)</b></li> <li>● <b>Text and sentiment analysis</b></li> <li>● <b>Web and social media analytics</b></li> </ul>	10
6	<b>Introduction to OLTP and OLAP</b> <ul style="list-style-type: none"> <li>● Different OLAP Architectures</li> <li>● Data models for OLTP and OLAP</li> <li>● Role of OLAP Tools in BI Architecture</li> </ul>	8

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Fundamentals of Business Analytics	RN Prasad, Seema Acharya	Wiley
2	Business Analysis Fundamentals	Haydn Thomas – Demonoid	Pearson

Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV		
<b>Course Code:</b> COMCA64201	<b>Course Name: Introduction to Cryptography</b>	<b>Total Lectures:</b> <b>30 Hours</b>
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Concepts of Networking</li> <li>● Operating System</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● Explain the importance and application of each of confidentiality, integrity, authentication and availability .</li> <li>● Explain the objectives of information security. Understand various cryptographic algorithms.</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able to: <ul style="list-style-type: none"> <li>● Understand basic cryptographic algorithms, message and web authentication.</li> <li>● Identify information system requirements for both of them such as client and server and security issues.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Lectures</b>
1	Introduction <ul style="list-style-type: none"> <li>● Need of cyber security</li> <li>● security goals (confidentiality, integrity, availability)</li> <li>● Plain text and cipher text</li> <li>● Encryption and decryption</li> </ul>	6
2	System security <ul style="list-style-type: none"> <li>● Transposition techniques</li> <li>● Substitution techniques,</li> <li>● Symmetric and asymmetric key cryptography,</li> <li>● Steganography</li> </ul>	12
3	<b>Encryption Algorithms</b> <ul style="list-style-type: none"> <li>● Block Cipher</li> <li>● Stream ciphers</li> <li>● Introduction of International Data Encryption Algorithm (IDEA), Data Encryption Standard (DES), Advanced Encryption Standard (AES) ,RSA</li> <li>● Digital certificate, Message-Digest Algorithms</li> </ul>	12

**References:**

Sr. No.	Title of the Book	Author/s	Publication
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1	Cryptography and Network Security	William Stallings	4th Edition, Pearson, 2009.
2	Behrouz A.Forouzan	Cryptography and Network Security	Tata McGraw-Hill, 2008

<b>Modern College of Arts, Science and Commerce (Autonomous), Ganeshkhind, Pune 411016 M.Sc. (Computer Science) Year- II Semester- IV</b>		
<b>Course Code:</b> COMCA64202	<b>Course Name: Cyber Security Practical</b>	<b>Total Lectures:</b> 30 Hours
<b>Teaching Scheme:</b> 2 hrs/week	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks	<b>No. of Credits:</b> 2
<b>Course Prerequisites:</b>	<b>Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Operating System</li> <li>● Networking Concepts</li> </ul>	
<b>Course Objectives:</b>	<ul style="list-style-type: none"> <li>● To focus on the tools, and techniques for enforcement of security</li> <li>● To learn security from multiple perspectives.</li> </ul>	
<b>Course Outcomes:</b>	After successfully completing this course, students will be able : <ul style="list-style-type: none"> <li>● To develop basic understanding of cyber security</li> <li>● To understand system attacks and defences against them.</li> </ul>	
<b>Chapter</b>	<b>Course Contents</b>	<b>No. of Sessions</b>
1	Caesar cipher in Cryptography	4
2	Shift cipher in Cryptography	4

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3	Brute Force Approach to Break Caesar Cipher	4
4	Decrypt Caesar Cipher	3
5	Encryption using transposition cipher	4
6	Decryption using transposition cipher	3
7	Implementation of simple MD5	4
8	Implementation of RSA	4

**References:**

Sr. No.	Title of the Book	Author/s	Publication
1	Cryptography and Network Security	William Stallings	4th Edition, Pearson, 2009.
2	Behrouz A.Forouzan	Cryptography and Network Security	Tata McGraw-Hill, 2008
3	Cryptography and Network Security	Atul Kahate	McGraw Hill