SAVITRIBAI PHULE PUNE UNIVERSITY

PUNE

CHOICE BASED CREDIT SYSTEM

Syllabus for Third Year
B.Sc. (Information Technology)
(2022 Pattern)

(with effect from Academic Year 2024-25)

Structure of T.Y.B.Sc.(IT)

SEMESTER -V

Course Type	Course Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	TOTAL
DSE	IT-351	Advanced Java Programming	4	-	30	70	100
DSE	IT-352	Cryptography and Network security	4	-	30	70	100
DSE	IT-353	Computer graphics and Animation	4	-	30	70	100
DSE	IT-354	Lab Course on Advanced Java Programming	-	2	15	35	50
DSE	IT-355	Lab Course on Cryptography and Network security	-	2	15	35	50
DSE	IT-356	Lab Course on Computer Graphics and Animation	-	2	15	35	50
SECC-I	IT-357	Big Data Analytics	2	-	15	35	50
SECC-II	IT-358	Cloud Computing	2	-	15	35	50

Total Credits: 22

SEMESTER – VI

Course Type	Course Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	TOTAL
DSE	IT-361	Mobile Application Development	4	-	30	70	100
DSE	IT-362	Software Testing	4	-	30	70	100
DSE	IT-363	Data Mining	4	-	30	70	100
DSE	IT-364	Lab Course on Mobile Application Development	-	2	15	35	50
DSE	IT-365	Lab Course on Software Testing	-	2	15	35	50
DSE	IT-366	Lab Course on Data Mining	-	2	15	35	50
SECC-III	IT-367	Block Chain Technology	2	-	15	35	50
SECC-IV	IT-368	Emerging Technologies	2	-	15	35	50

Total Credits: 22

*DSE: Discipline Specific Elective

*SECC: Skill Enhancement Compulsory Course

SEMESTER - V

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-351
Title: Advanced Java Programming

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	4	CA:30 marks UA:70 marks

Prerequisites: Core Java concepts

Course Objectives:

1. To know the concept of Java Programming.
2. To understand how to use programming in day to day applications.
3. To develop programming logic

Course Outcomes (Cos) :

1. Students will know the concepts of JDBC Programming
2. Students will know the concepts of Spring and Hibernate.
3. Students will develop the project by using JSP and JDBC.
4. Students will develop applications in Spring and hibernate.

Course Contents

Chapter 1	**Collection Framework**	**08 hours**

1.1 Introduction to the Collection framework
1.2 List ArrayList, LinkedList
1.3 Set - HashSet, TreeSet,
1.4 Map - HashMap and TreeMap
1.5 Interfaces such as Comparator, Iterator, ListIterator, Enumeration

Chapter 2	**Networking**	**06 hours**

2.1Overview of Networking.
2.2 Networking Basics: Port Number, Protocols and classes.
2.3 Sockets, Reading from and Writing to a Socket
2.4 Server Socket class, Reading from and Writing to a Server Socket
2.5 Datagrams – Datagram Packet, Datagram Server and Client

Chapter 3	**AWT and Swing**	**13 hours**

3.1What is AWT ?
3.2 Components – Button, Label, Text, Text Area, CheckBox and RadioButton, List, ComboBox
3.3Layout Manager and Layouts
3.4 Event Handling: Event sources, Listeners, Mouse and Keyboard Event Handling
3.5 What is Swing? Difference between AWT and Swing.
3.6 Components – JButton, JLabel, JText, JTextArea, JCheckBox and JRadioButton, JList, JComboBox, JMenu and JPopupMenu Class, JMenuItem, JCheckBoxMenuItem, JRadioButtonMenuItem, JScrollBar, JColorChooser, JTable, JFileOpen, JTabbed Pane

Chapter 4	JDBC	09 hours

4.1 Introduction
4.2 JDBC Architecture.
4.3 JDBC Process
4.4 Working with ResultSet Interface.
4.5 JDBC Metadata

Chapter 5	Servlet and JSP	12 hours

Servlet
5.1 Introduction to Servlet
5.2 Types of Servlet: Generic Servlet and Http Servlet
5.3 Life cycle of servlet
5.4 Session Tracking.
5.5 Servlet with database.
JSP
5.6 Introduction to JSP.
5.7 JSP Life Cycle.
5.8 Components of JSP.
5.9 JSP with Database

Chapter 6	Spring Framework	12 hours

6.1 Introduction of Spring framework
6.2 Spring Modules / Architecture
6.3 Spring Applications
6.4 Spring MVC
6.5 Spring MVC Forms, Validation
6.6 Hello World Example
6.7 Core Spring – IoC Containers, Spring Bean
Hibernate
6.6 Architecture and Environment
6.7 Configuration, Sessions, Persistent Class
6.8 Mapping Files, Mapping Types
6.9 Examples

Text Books:
1. Programming with JAVA - E Balgurusamy
2. The Complete Reference – JAVA Herbert Schildt
References:
1. The Complete Reference – JAVA Herbert Schildt
2. Professional Hibernate, by Eric Pugh, Joseph D. Gradecki by Wiley Publishing, Inc., ISBN: 0-7645-7677-1
3. Spring In Action, Craig Walls, Ryan Breidenbach, Manning Publishing Co., ISBN: 1- 932394- 35-4
4. Head First Servlets and JSP: Passing the Sun Certified Web Component Developer Exam -2nd Edition-Bryan Basham, Kathy Sierra, Bert Bates- O'REILLY.

Online Resources:

https://www.javatpoint.com/java-tutorial
https://www.w3schools.com/java/

Savitribai Phule Pune University
IT-352
Title: Cryptography and Network Security

Teaching Scheme	No. of Credits	Examination Scheme
4 hours / week	4	CA: 30 Marks UA: 70 Marks

Prerequisites:

- Strong foundation in mathematics.

Course Objectives:

1. To understand and impart knowledge of Cryptography and Network Security.
2. To know about various encryption, decryption and intrusion detection techniques.
3. To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes: On completion of the course, students would be able to -

1. Do research in the emerging areas of cryptography and network security.
2. Summarize the encryption, decryption and intrusion detection techniques and its solutions to overcome the attacks.
3. Protect network from the threats by applying appropriate network security protocols.

Course Contents

Chapter 1	**Introduction**	**8 hours**

1.1 Introduction : Introduction to Security
1.2 Security Approaches
1.3 Principles of Security
1.4 Security Threats
1.5 Active and Passive Attacks
1.6 CIA Model

Chapter 2	**Basics of Cryptography and Encryption**	**12 hours**

2.1 Introduction to Cryptography
2.2 Plain Text and Cipher Text
2.3 Symmetric Cipher Model
2.4 Cryptography, Cryptanalysis, Brute Force Attacks
2.5 Substitution Techniques - Caesar Cipher and Modified Caesar Cipher, Mono Alphabetic cipher, Poly-Alphabetic Cipher, Playfair Cipher
2.6 Transposition Techniques- Rail Fence technique, Simple Columnar transposition Technique
2.7 Encryption and Decryption-Symmetric and Asymmetric key cryptography
2.8 Steganography
2.9 Key Range and Key Size

Chapter 3	**Block ciphers and Data encryption standards**	**8 hours**

3.1 Stream ciphers
3.2 Block Ciphers
3.3 Block Cipher modes of operation: ECB, CBC, CTR
3.4 Data Encryption Standard, DES Example
3.5 RC4

3.6 RC5
3.7 Blowfish
3.8 AES structure, AES transformation function

Chapter 4	**Public Key Cryptography and Asymmetric**	**8 hours**

4.1 Introduction to number theory
4.2 Principles of public key cryptosystems
4.3 RSA algorithm - algorithm and example,
4.4 Diffie Hellman key exchange algorithm and example
4.5 Public key – distribution of secret keys, elliptic curve cryptography

Chapter 5	**Hash Functions and Digital Signatures**	**12 hours**

5.1 Authentication Requirement
5.2 Authentication Function
5.3 Message Authentication Code
5.4 Hash Function
5.5 Digital Signature Concept
5.6 Security of Hash Function and MACs.
5.7 Public Key Infrastructure (PKI)
5.8 Kerberos, X.509 Authentication Service,

Chapter 6	**IP Security & Intrusion Detection Systems**	**12 hours**

6.1 IP Security Overview
6.2 IP Security Architecture
6.3 Authentication Header
Encapsulating Security Payload,
Combining Security Associations and Key Management
SSL and TSL
Pretty Good Privacy (PGP)
6.4 Firewall
VPN
6.5 Intrusion detection: Overview
6.6 Approaches for IDS/IPS

Reference Books:

1. Cryptography and Network Security by Atul Kahate, 4th Edition, Tata McGraw Hill
2. Cryptography and Network Security by William Stallings, 8th Edition, Pearson Education.

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
IT- 353
Title: Computer Graphics and Animation

Teaching Scheme	No. of Credits	Examination Scheme
4 hours / week	4	CA: 30 Marks UA: 70 Marks

Prerequisites : Basic computer knowledge.

Course Objectives:

- Image Editing: Develop image editing expertise crucial for graphic design and data visualization in projects.
- 2d Vector Animation: Acquire animation skills essential for creating interactive interfaces and engaging multimedia content in software development.

Course Outcomes (Cos) :

Upon successful completion of this course, **the students will be able to:**

- navigate the Image editing interface efficiently.
- Understand fundamental design principles such as composition, color theory, and typography.
- Get knowledge of various image editing techniques including cropping, resizing, retouching, and compositing.
- Understand file formats and optimization techniques for web and print output.
- Understand the basic principles of animation such as timing, spacing, and squash and stretch.
- Learn how to navigate and utilize animation software interface efficiently.
- Explore keyframe animation techniques for creating motion sequences.

Course Contents

Chapter 01	**Introduction to Image Editing**	**8 hours**

Workspace

1.1 Workspace basic
1.2 Palettes and Menus
1.3 Toolbar – selection tools, painting tools, editing and retouching tools, zoom tools
1.4 Viewing images Ruler, Guide and Grids

Chapter 02	**Preferences, Color, Layers**	**8 hours**

2.1 Recovery and undo Memory and Performance
2.2 Images Editing
2.3 Image size and Resolution
2.4 High dynamic range images
2.5 Converting between color modes
2.6 File, Edit Image View

Chapter 03	Type, Filters, Masking	9 hours
3.1 The type tool 3.2 Area type tool, Path type, Vertical type tool 3.3 Wrap text 3.4 Introduction to Filter basics 3.5 Filter effect 3.6 Applying specific filters, Add Lighting Effects 3.7 Liquify filter, Vanishing Point, Create panoramic images 3.8 Clipping Mask, Vector Mask, Layer Mask		
Chapter 04	**Overview of 2d Animation**	**8 hours**
4.1 Workflow Basics 4.2 Establish the concept and goals, Producing, Testing, and staging the presentation. 4.3 Start Page 4.4 Managing windows and Panel Creating custom workspace Layouts 4.5 Managing Windows and Panels 4.6 The Tool Panels 4.7 The Document		
Chapter 05	**Introduction to drawing and drawing tools in Flash**	**9 hours**
5.1 Geometric Shape Tools 5.2 Drawing Tools 5.3 Using Fill and Stroke Controls 5.4 Controlling the Tools Panel 5.5 Reading the tools Panel 5.6 Customizing the tools panel		
Chapter 06	**Setting stage dimensions, working with panels, panel layouts**	**9 hours**
6.1 Creating Layers 6.2 Editing frames and layers 6.3 Using Frame view options 6.4 Designing and Aligning Elements 6.5 Simplifying snapping setting 6.6 Design Panels 6.7 Text Field Types in Flash 6.8 The Text Tool and the Properties Panel 6.9 Front Export and Display		
Chapter 07	**Bitmap Images & Sounds, Symbol**	**9 hours**
7.1 Defining Vectors and Bitmaps 7.2 Identifying sound File Import and Export Format Editing Audio in Flash 7.3 Understanding the Document Library. 7.4 Editing Symbols. 7.5 Modifying Instance Properties.		

Reference books

1. Adobe Photoshop Bible cs5 by Lisa Danae Dayley, brad dayley --- Wiley India ISBN : 13 -9788126527199
2. Adobe Photoshop CS6 (Classroom in a Book) ISBN – 978-81-317-9164-6 By PEARSON Publications
3. Flash CS4 Professional Bible Published by Wiley Publishing (Robert R & Snow D.)2.FLASH MX For PC/Mac Published by – FIREWALL MEDIA – Laxmi Publications

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
IT-354
Title : Lab Course on Advanced Java Programming

Teaching Scheme	No. of Credits	Examination Scheme
3 hours/week	2	CA :15 marks UA :35 marks

Course Objectives:

- Covers the complete scope of the syllabus.
- Bringing uniformity in the way course is conducted across different colleges.
- Continuous assessment of the students.
- Advanced Java is designed to develop web based, network centric, Enterprise level applications

Course Outcomes:

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

- Learn database Programming using Java
- Understand and Create dynamic web pages using Servlets and JSP.
- Work with basics of framework to develop secure web applications

Assignments 1:- Collection

- Study the Collection framework in java.
- To implement various Interfaces and classes through algorithms.
- To Demonstrate Cursor Objects (Enumeration, Iterator, List Iterator, Comparator)

Assignments 2:- AWT and Swing

- To demonstrate GUI creation using Swing Package and Layout managers.
- To understand Event handling mechanism in Java.
- Using Event classes, Event Listeners and Adapters

Assignments 3:- Database Programming

- To communicate with a database using java.
- To execute queries on tables.
- To obtain information about the database and tables.

Assignments 4 :- Servlet

- To understand server-side programming.
- Simple steps to create and execute servlets.
- How to pass parameters using doGet and doPost methods.
- Handling data from HTML to servlet .
- How to connect servlet to a database .
- Use of various session tracking methods like Cookies.

Assignments 5:- Java Server Pages

- JSP life-cycle.
- Use of JSP implicit objects.
- JSP Directives.
- Use of Scripting Elements.
- To understand actions tags in JSP.
- Understanding flow of JSP custom tags.

Assignments 6:- Spring Framework

- To create and understand the steps to develop Spring application.

Reference Books :

1. Programming with JAVA - E Balgurusamy

2. The Complete Reference – JAVA Herbert Schildt

Savitribai Phule Pune University
IT-355
Title: Lab Course on Cryptography and Network Security

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA: 15 Marks UA: 35 Marks

Prerequisites:

- Strong foundation in mathematics.

Course Objectives:

- To enable students learn different encryption technique
- To enable students learn symmetric and asymmetric algorithms

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

- Develop understanding of substitution and transposition techniques
- Develop understanding of Symmetric and Asymmetric algorithm

Practical Assignments

Perform the following Assignments using **Python**

Assignment 1:-Substitution Technique
Write a Program to implement Substitution techniques

Assignment 2:-Transposition Technique
Write a Program to implement Transposition techniques

Assignment 3:-DES Algorithm
Write a Program to implement DES Algorithm

Assignment 4:-AES Algorithm
Write a Program to implement AES Algorithm

Assignment 5:-RSA Algorithm
Write a Program to implement RSA Algorithm

Assignment 6:- Diffie Hellman Key Exchange Algorithm
Write a Program to implement Diffie Hellman Key Exchange Algorithm

Assignment 7:- SHA Algorithm
Write a Program to implement SHA Algorithm

Reference Books:

1. Cryptography and Network Security by Atul Kahate, 4th Edition, Tata McGraw Hill
2. Cryptography and Network Security by William Stallings, 8th Edition, Pearson Education.

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT- 356
Title : Lab Course on Computer Graphics and Animation

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA :15 marks UA : 35 marks

Prerequisites :
Basic Computer knowledge

Course Objectives:

- To understand basic concept of 2d Animation and image editing
- To become familiar with image editing software and vector based software.

Course Outcomes:

Upon successful completion of this course, the students will be able to:

- Ability to navigate the Image editing interface efficiently.
- Understanding of fundamental design principles such as composition, color theory, and typography.
- Knowledge of various image editing techniques including cropping, resizing, retouching, and compositing.
- Understanding of file formats and optimization techniques for web and print output.
- Understand the basic principles of animation such as timing, spacing, and squash and stretch.
- Learn how to navigate and utilize animation software interface efficiently.

Practical Assignments

1. **Adding and removing elements from background.**
   Create an image manipulation by adding or removing objects or human character in image using image editing software.

2. **Converting black and white photo to Color.**
   Colorize black and white image using image adjustment option.

3. **Removing scratches and restoring old photos.**
   Remove scratch and clean old or damage photo using stamp clone tool.

4. **Coloring Cartoon/Comic Character.**
   Trace any cartoon image.

5. **2d Animation.**
   Bouncing Ball using Animation Principal

6. **Create web page on ecommerce site using photoshop.**
   Create a webpage design on ecommerce site like amazon.

7. **Create arc or swing animation.**
   Create arc animation pendulum, or double pendulum using arc principle of animation.

Reference books:

4. Adobe Photoshop Bible cs5 by Lisa Danae Dayley, brad dayley --- Wiley india ISBN 13 -9788126527199
5. Adobe Photoshop CS6 (Clasroom in a Book) ISBN – 978-81-317-9164-6 By PEARSONPublications
6. Flash CS4 Professional Bible Published by Wiley Publishing (Robert R & Snow D.)2.FLASH MX For PC/Mac Published by – FIREWALL MEDIA – Laxmi Publications

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-357
Title : Big Data Analytics

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA: 15 marks UA: 35marks

Prerequisites:

1. Should have knowledge of one Programming Language (Java or Python or R Programming).
2. SQL knowledge to query data and manipulate information stored in databases
3. Data warehousing and data mining to extract trends from data
4. Analytical and Problem-Solving Skills.
5. Mathematics and Statistics concepts are clear.

Course Objectives:

1. To enable learners to develop expert knowledge and analytical skills in current and developing areas of analysis statistics, and machine learning
2. To enable the learner to identify, develop and apply detailed analytical, creative, problem solving skills.
3. To study the basic technologies that forms the foundations of Big Data.
4. To Provide an overview of Apache Hadoop, Map Reduce and Interfacing with HDFS
5. To understand the Big Data Platform and its Use cases.
6. To study different types Case studies on the current research and applications of the Hadoop and big data in industry

Course Outcomes (Cos) :

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

CO1: represent the analytical aspects of Big Data

CO2: understand the specialized aspects of big data with the help of different big data applications

CO3: Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.

CO4: Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.

CO5: Design and Implementation of Big Data Analytics using pig and Hive to solve data intensive problems and to generate analytics.

Course Contents

Chapter 1	**Introduction to Big Data and Hadoop**	**4 hours**

Introduction to Big Data, Sources of Big Data, 5 V's of Big Data, Application of Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Features of Hadoop, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Ecosystem.

Chapter 2	HDFS (Hadoop Distributed File System)	4 hours
What is HDFS?, Features of HDFS, HDFS Architecture, Read and Write operation in HDFS, Concept of Block in HDFS, Hadoop HDFS Commands		
Chapter 3	**Map Reduce**	**4 hours**
What is Map Reduce?, Advantages of Map Reduce, Parallel processing issues using traditional approach, Parallel processing using map-reduce approach, Map reduce word count example, running inbuilt word count example, Hadoop map reduce/YARN components.		
Chapter 4	**Apache Pig and Apache Hive**	**8 hours**
Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive :** Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.		
Chapter 5	**Big Data Analytics with R**	**10 hours**
History, Features of R, Data Structures in R (Vector, List, Array, Matrix, Data Frame, Factors), Data Visualization in R (Bar chart, Scatter plot, Histogram, Box plot)		

Reference Books:

1. Big Data: Concepts, Technology and Architecture by Balamarugan Balusamy, Nandhini Abirami R, Seife dine Kadry and Amir Gandomi, wiley publication
2. Big Data Processing for Beginners: A Step-by-Step Guide to Mastering Big Data Analytics by Brian Paul

Online Resources:

1) https://www.coursera.org/lecture/data-analysis-with-python/exploratory-data-analysis-iNeWs
2) https://www.w3schools.com/
3) https://www.geeksforgeeks.org/
4) https://www.javatpoint.com

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
IT-358
Title: Cloud Computing

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA: 15 marks UA: 35 marks

Prerequisites

Programming Skills, Familiarity with Operating System and Databases, Basics of Networking Security

Course Objectives:

- To study cloud computing concepts, technologies, and architectures.
- To understand the implementation of Virtualization in Cloud Computing.
- To learn the application and security of cloud computing.
- To study risk management in cloud computing.
- To understand the advanced technologies and recent trends in cloud computing
- To understand issues in application deployment and implementations in cloud environment.

Course Outcomes (Cos) :

Upon successful completion of this course, **the students will be able to:**

- ❖ Choose the appropriate technologies, algorithms, and approaches for the given application.
- ❖ Compare and Contrast various cloud services.
- ❖ Understand the different Cloud Computing environment.
- ❖ Analyze virtualization technology and install virtualization software.
- ❖ Apply security in cloud applications
- ❖ Explain the core issues in cloud computing such as security, privacy, and interoperability.
- ❖ Use advance techniques in Cloud Computing.

Course Contents

Chapter 1	**Introduction to Cloud Computing**	**4 hours**

1.1 Overview of Cloud Computing

1.2 Features of Cloud Computing, Essential Characteristics of Cloud Computing.

1.3 Benefits and Disadvantages of Cloud Computing.

1.4 Cloud Computing Architecture: Front End and Back End.(Cloud Computing Logical Architecture, Cloud System Architecture.)

Chapter 2	Cloud deployment and Services models	10 hours

2.1 Migrating into the Cloud: Seven-step model of migration into a Cloud.

2.2 Cloud Service Models: SaaS, PaaS, IaaS, Serverless computing.

2.3 Cloud Computing Reference Model

2.4 Cloud Deployment Models: Public, Private, Hybrid and Community.

2.5 Load Balancing Techniques/Algorithm: Round Robin and Weighted RR, Low Latency ,Least Connections, Priority and Request Based and Overflow .

Chapter 3	Virtualization in Cloud Computing	6 hours

3.1 Introduction of Virtualization: Virtual infrastructures, Need for Virtualization

3.2 Types of Virtualization:

Hardware virtualization: Full Virtualization, Para Virtualization and Partial Virtualization
Network Virtualization: Internal and External
Software Virtualization: OS, Application and Service
Storage Virtualization: File level and block level
Memory Virtualization: Application-level integration and Operating System Level Integration
I/O Virtualization

3.3 Understating Hypervisors and Virtual Machine types: Process and System Virtual Machine.

Chapter 4	Cloud Platforms and Cloud Applications	5 hours

4.1 Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).

4.2 Microsoft Cloud Services: Azure core concepts, SQL Azure

4.3 Cloud Computing Applications:

Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking,

Google Cloud Application: Google App Engine.

Chapter 5	Security in Cloud Computing	02 hours

5.1 Risks in Cloud Computing: Risk Management, Types of Risks in Cloud Computing.

5.2 Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization

5.3 Challenges in the Cloud, Security Issues in Cloud Computing.

Chapter 6	Advanced Techniques in Cloud Computing	03 hours

6.1 Future Tends in cloud Computing :Mobile Cloud

6.2 Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes,

6.3 IOT and Cloud Convergence: The Cloud and IoT in your Home and Automobile

6.4 Introduction to DevOps.

Reference Books:

1) Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
2) Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010.
3) Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, Brian J. S. Chee and Curtis Franklin.
4) Microsoft Azure: Planning, Deploying, and Managing Your Data Center in the Cloud, Anthony Puca, Mike Manning, Marshal Copeland, Julian Soh, David Gollob.
5) Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
6) Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0
7) Cloud Computing: Principles and Paradigms, Editors, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011.
8) Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010.

Online Resources:

https://openlibrary.org/

https://nlist.inflibnet.ac.in/

https://archive.org/

https://books.google.co.in/

https://en.wikibooks.org/wiki/Main_Page

SEMESTER – VI

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-361
Title: Mobile Application Development

Teaching Scheme	No. of Credits	Examination Scheme
4 hours / week	4	CA: 30 marks UA: 70 marks

Pre requisites :

- Knowledge of JAVA programming language and OOP concept.

Course Objectives:

- To understand the Android Operating System
- To study Android Apps Development Cycle
- To learn to create Android Applications

Course Outcomes (Cos) :

- After successful completion of this course, learner will be able to:
- Describe the process of developing mobile applications.
- Create mobile applications on the Android Platform.
- Design and implement mobile applications involving data storage in SQLite database
- Use location-based services while developing application

Course Contents

Chapter 1	**Introduction to Android**	**08 hours**

1.1 . What is Android?
1.2 . History
1.3 . Features of Android
1.4 . Architecture of Android
- Overview of Stack
- Linux Kernel
- Native Libraries
- Android Runtime
- Application Framework
- Applications

1.5. SDK Overview
- Platforms
- Tools – (JDK, SDK, Eclipse/Android Studio, ADT, AVD, Android Emulator), Versions

1.5 AndroidManifest.xml
1.6 Emulator-Android Virtual Device
1.7 Resources & R.java, Assets
1.6. Creating your first Android Application

Chapter 2	Basic UI design	14 hours

2.1. Basic UI Designing (Form widgets ,Text Fields ,
Layouts ,[dip, dp, sip, sp] versus px
2.2 Using Basic Views

- TextView
- Button,
- ImageButton,
- EditText,
- CheckBox
- Switch,
- ToggleButton,
- RadioButton, and RadioGroup Views
- ProgressBar View
- AutoCompleteTextView View

2.3 Understanding the components of a screen

- Views and View Groups
- Linear Layout
- Absolute Layout
- Table Layout
- Relative Layout
- Frame Layout
- Scroll Layout
- Scroll View
- Constraint Layout

Chapter 3	Activities and Intents	10 hours

3.1 Introduction to Activities
3.2. Activity Lifecycle
3.3. Introduction to Intents
3.4. Linking Activities using Intents
3.5. Calling built-in applications using Intents
3.9. Toast

Chapter 4	Designing Your User Interface with Views	6 hours

4.1. Split Screen / Multi-Screen Activities
4.3. Using Picker Views

- TimePicker View
- DatePicker View

4.4. Using List Views to Display Long Lists

- ListView View
- Using the Spinner View

Chapter 5	Displaying Pictures , Menus and Video	6 hours

5.1. Using Image Views to Display Pictures

- Gallery and ImageView views
- Image Switcher
- Grid View

5.2. Using Menus with Views

- Creating the helper methods
- Options Menu
- Context Menu

5.3. VideoView

- Play video from URL with using VideoView
- VideoView Create
- Optimized VideoView
- Optimized VideoView in ListView

Chapter 6	Databases – SQLite	6 hours

6.1. Introduction to SQLite

6.2. SQLite Open Helper and SQLite Database

6.3. Creating , opening and closing database

6.4. Working with cursors, Insert, Update, Delete

6.5. Building and executing queries

Chapter 7	Messaging and E-mail and Google Map	10 hours

7.1. SMS Messaging

- Sending SMS Messages Programmatically
- Sending SMS Messages Using Intent
- Receiving SMS Messages

7.2 Sending E-mail

7.3. Display Google Maps

- Creating the project
- Obtaining the Maps API Key
- Displaying the Map
- Displaying the Zoom Control
- Changing Views
- Navigating to a specific location
- Adding Markers
- Geocoding and Reverse Geocoding

7.4 Getting Location Data

References Books:

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

E-Books:

1. https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-ProgrammingCookbook.pdf
2. https://www.programming-book.com/download/?file=10988
3. http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
4. https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1. The official site for Android developers - https://developer.android.com
2. https://www.tutorialspoint.com/android/index.htm
3. https://www.javatpoint.com/android-tutoria

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-362
Title: Software Testing

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	4	CA: 30 marks UA:70 marks

Prerequisites :

- Basics of Software Engineering
- Software Engineering Paradigms

Course Objectives:

To study fundamental concepts of software testing.

- To discuss various software testing issues.
- To learn how to plan, and design test cases.
- To learn to manage software problems and defects.
- To learn to generate a testing report.

Course Outcomes (Cos) :

- Students will be able to apply software testing knowledge and engineering methods.
- Students will be able to plan test cases.
- Students will be able to design test cases.
- Students will be able to design defect report.

Course Contents

Chapter 1	**Introduction to Testing**	**08 hours**

1.1 Introduction to Software testing
1.2 Testing Objectives
1.3 Testing principles
1.4 Testing fundamentals
1.5 V-V Model

Chapter 2	**Approaches to Testing –Testing Methods**	**08 hours**

2.1 White Box Testing
2.2 Types of white box testing
2.3 Black Box Testing
2.4 Types of black box testing

Chapter 3	**Software Testing Strategies**	**12 hours**

3.1 Software Testing Process
3.2 Unit Testing
3.3 Integration- Top-down, Bottom up
3.4 System Testing
3.5 Acceptance Testing (alpha, Beta testing)
3.6 Big Bang Approach
3.7 Sandwich approach

3.8 Performance Testing
3.9 Regression Testing
3.10 Smoke Testing
3.11 Load Testing

Chapter 4	**Software Testing Life Cycle**	**08 hours**

4.1 Overview of the stages of STLC:
- Test strategy
- Test planning
- Test design
- Test execution
- Test reporting

4.2 Test Case Design
- Entry criteria
- Exit Criteria

4.3 Test Cases for Entry and Exit Criteria

Chapter 5	**Agile testing and Defect Management**	**12 hours**

5.1 Agile Testing,
5.2 Difference between Traditional and Agile testing,
5.3 Agile principles and values,
5.4 Agile Testing Quadrants,
5.5 Defect Life Cycle
5.6 Defect Classification
5.7 Defect Report
5.8 Defect management
- Finding defects
- Logging defects
- Tracking and managing defects

Chapter 6	Test Templates, and test case creation and use	**12hours**

6.1 Test scenario template
6.2 Test case template
6.3 Test plan
6.4 Design test case for given application
6.5 Design test cases in excel
6.6 Prepare test report for test cases

References:

1. Software Engineering – A Practitioners Approach, Roger S. Pressman, 7th Edition, Tata McGraw Hill
2. Srinivasan Desikan and Gopalaswami Ramesh – Software Testing Principles and practices – Pearson Education India
3. Effective Methods of Software Testing – William E Perry, 3rd Edition, Wiley Publishing Inc

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-363
Title: Data Mining

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	4	CA: 30 Marks UA:70 Marks

Prerequisites :
IT-112 Fundamentals of Databases
IT-113 Mathematical Techniques for IT

Course Objectives:

1. To introduce students the basic concepts and techniques of Data Mining
2. To study data mining algorithms for solving practical problems.
3. Be familiar with mathematical foundations of data mining tools.
4. To understand data mining techniques in various applications like social, scientific and environmental context.
5. Develop skill in selecting the appropriate data mining algorithm for solving practical problems.

Course Outcomes (Cos) :

On successful completion of this course, **students will be able to:**

- Understand the functionality of the various data mining component.
- Explain the analyzing techniques of various data.
- Describe different methodologies used in data mining.
- Analyze the frequent patterns using association analysis algorithms like apriori etc.
- Develop ability to design various algorithms based on data mining tools.

Course Contents

Chapter 01	**Introduction to Data Mining**	**10 Lectures**

1.1 Basic of Data: Data, Information and Data mining.
1.2 Data Mining Tasks: Descriptive and Predictive
1.3 Knowledge Discovery in Databases (KDD).
1.4 Data Mining Techniques/Tasks
1.5 Data Mining Issues.
1.6 Applications of Data Mining.

Chapter 02	**Introduction to Data Warehousing.**	**14 Lectures**

2.1 Introduction of Data warehouse
2.2 Characteristics of Data warehouse
2.3 Architecture of Data warehouse.
2.4 Data Modeling
2.4.1 Types of OLAP
2.4.2 OLTP Vs OLAP
2.4.3 Data Mart and Data Cubes,
2.4.4 Fact Table and Dimension Table
2.4.5 Different OLAP Operations

2.5 Dimensional Data Modeling
- 2.5.1 Star Schema
- 2.5.2 Snowflake schema

Chapter 03	Classification and Regression	14 Lectures

3.1 Introduction, Definition
3.2 Decision tree
- 3.2.1 Construction Principle
- 3.2.2 Issues
  - Over-fitting
  - Tree pruning methods
  - Attribute selection Measures

3.3 Rule-Based Classification
3.4 Random Forests
3.5 Support Vector Machines (SVM)
3.6 K-Nearest neighbor Algorithm and its numerical
3.7 Bayesian Classification
- 3.7.1 Bayes Theorem,
- 3.7.2 Naïve Bayes classifier

3.8 Regression
- 3.8.1 Linear regression
- 3.8.2 Non-linear regression
- 3.8.3 Logistic Regression

Chapter 04	Clustering	8 Lectures

4.1 Basics of Clustering
4.2 Types of Clustering
4.3 Hierarchical clustering
- 4.3.1 Divisive
- 4.3.2 Agglomerative

4.4 K-means

Chapter 05	Association	8 Lectures

5.1 Introduction
5.2 Association Rule Mining
- 5.2.1 Support
- 5.2.2 Confidence
- 5.2.3 Itemsets
- 5.2.4 Frequent item-sets
- 5.2.5 Market Basket Analysis

5.3 Apriori algorithm

Chapter 06	Software for Data Mining and Applications of Data Mining	6 Lectures

R Programming Basics (Decision Making and Loops, Vectors, List, Matrix, Factors, Data Frame) and Jupyter/Spyder notebook or Anaconda Navigator or any IDLE of python on any platform.

Reference books

1. Data Mining Concepts and Techniques by Jiawei Han and Micheline Kamber, ELSEVIER, Third Edition, ISBN: 9780123814791, 9780123814807
2. Data Mining : Introductory and Advanced Topics by Margaret Dunham, S. Sridhar, Pearson Publication
3. R and Data Mining by Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638
4. Data Mining: Concepts and Techniques by Han, Elsevier ISBN:9789380931913/9788131205358
5. Machine Learning, by Tom Mitchell, McGraw-Hill, 1997
6. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer 2006
7. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, McGraw Hill

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-364
Title: Lab Course on Mobile Application Development

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA :15 marks UA : 35 marks

Prerequisites :

- Knowledge of JAVA programming language and OOP concept

Course Objectives:

- Creating robust mobile applications and learn how to integrate them with other services.
- Creating intuitive, reliable mobile apps using the android services and components.

Course Outcomes:

- Design and develop user interfaces for mobile apps using basic building blocks, UI components and application structure using Emulator
- Build enterprise level mobile applications with on Android
- Understand both the basic and advanced concepts of Android Programming

Practical Assignments

Assignments-1 Introduction to Android

1. Create android application to change Font Size, Color and Font Family of String.
2. Execute the Hello World Application on Physical Device.

Assignments-2 Activities and Intents

1. Create a Simple Application which shows the Life Cycle of Activity.
2. Create a Simple Application Which Send ―Hello! message from one activity to another with help of Button (Use Intent).
3. Create an Android Application to accept two numbers and find power and Average. Display the result on the next activity on Button click.
4. Create an Android App with Login Screen. On successful login, gives message go to next Activity (Without Using Database& use Table Layout).

Assignments-3 User Interface with Views

1. Create an Android Application that Demonstrate Alert Dialog Box.
2. Create an Android Application to demonstrate the Simple calculator.
3. Create an application to demonstrate date and time picker.
4. Demonstrate Array Adapter using List View to display list of Country.
5. Create an Android application to demonstrate Progress Dialog Box .

Assignments-4 Pictures and UI design

1. Construct an Android Application to accept a number and calculate Factorial. Sum of Digits of a given number using Context Menu.
2. Create gallery application to display all images.
3. Create a Android Application to demonstrate Vertical Scroll Bar
4. Android User Interface Design following-add a border to an Android Layout

Assignments-5 Databases – SQLite

1. Demonstrates the basics of ListActivity. Use a SQLite database to store the notes.
2. Create an android Application for performing the following operation on the table Customer (id, name, address, phno). (use SQLite database)
   i. Insert New Customer Details.
   ii. Show All the Customer Details on Toast Message.

Assignments-6 Messaging, E-mail and Google Map

1. Create application to send and receive messages.
2. Create an Android application to send email.

3. Create an Android Application to perform Zoom In, Zoom Out operation and display Satellite view, on Google Map.

References Books:

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

E-Books:

3. https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-ProgrammingCookbook.pdf
4. https://www.programming-book.com/download/?file=10988
5. http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
6. https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1. The official site for Android developers - https://developer.android.com
2. https://www.tutorialspoint.com/android/index.htm
3. https://www.javatpoint.com/android-tutorial

Savitribai Phule Pune University
IT-365
Title: Lab Course on Software Testing

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA: 15 Marks UA: 35 Marks

Prerequisites:

- Software Concepts

Course Objectives:

- To enable students to write test cases.
- To enable students to find and manage defects.

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

- Plan and design test cases.
- Find and manage defects.
- Could provide suggestions to improve user experience.

Practical Assignments

Assignment 1:-Entry and Exit Criteria
Write test case for entry and exit criteria.

Assignment 2:- Test Plan
Write test plan for a given application.

Assignment 3:- Test Cases in Excel for given application
Write test case in excel.

Assignment 4:- Test Cases for white box testing
Write test cases for applying statement, decision, loop, branch coverage criteria.

Assignment 5:- Test Cases for black box testing
Write test cases for applying ECP, BVA.

Assignment 6:-Defect Finding
To find defect from a given scenario.

Assignment 7:-Defect Report
Write a detailed defect report for a sample defect.

Assignment 8:- Suggestions to improve user experience
Provide Suggestions to enhance user experience.

Reference Books:

1. Software Engineering – A Practitioners Approach, Roger S. Pressman,7th Edition, Tata McGraw Hill
2. Srinivasan Desikan and Gopalaswami Ramesh- Software Testing Principles and practices – Pearson Education India
3. Effective Methods of Software Testing, William E Perry, 3rd Edition, Wiley Publishing Inc

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
IT-366
Title : Lab Course on Data Mining

Teaching Scheme	No. of Credits	Examination Scheme
3 hours/week	2	CA : 15 marks UA : 35 marks

Course Objectives:

- To study the basic concepts of Data Mining
- To study various data mining algorithms for solving practical problems.

Course Outcomes:

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

- Identify the key processes of data mining
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Identify appropriate data mining algorithms to solve real world problems

Assignments 1:- R Programming

R Programs using Decision Making and Loops, Vectors, List, Matrix, Factors, Data Frame

- For Following programs Use Jupyter/Spyder notebook or Anaconda Navigator or any IDLE of python on any platform.

Assignments 2:- Data Pre-processing

Programs based on Data Pre-processing

Assignments 3:- Classification
Programs based on various algorithms- SVM, K-nearest, Naïve Bayes, Decision Tree

Assignments 4 :- Association Rules
Programs based on algorithms - Apriori Algorithm

Assignments 5:- Regression
Programs based on various types of Regression.

Assignments 6 :- Clustering
Programs based on various algorithms - hierarchical clustering, k-means

Reference Books :

1. R and Data Mining, By Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638
2. Data Mining: Practical Machine Learning Tools and Techniques by Ian H. Witten, Eibe Frank, McGraw Hill

Savitribai Phule Pune University
T.Y.B.Sc.(Information Technology)
IT-367
Title: Block chain Technology

Teaching Scheme	No. of Credits	Examination Scheme:
3 Hours / week	2	CA : 15 marks UA : 35 marks

Prerequisite:

- Understanding of Object Oriented Programming Concepts
- Knowledge of Python

Course Objectives :

1. Understand what and why of block chain technology.
2. Explore major components of block chain.
3. Learn about Bitcoin, Cryptocurrency and Ethereum.

Course Outcomes :

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

1. Learn the fundamentals of Block chain Technology.
2. Learn Basic Block chain programming
3. Basic knowledge of Smart Contracts and how they function.

Course Contents

Chapter 1	Introduction to Blockchain	6 Lectures

- Foundational Computing Concepts (Client-Server systems vs Peer to Peer Systems)
- Evolution of Blockchain
- Block chain VS Database
- Block chain generations,
- Types of block chain,
- Benefits and challenges of block chain usage
- Types of Networks
- Layered Architecture of Block chain Ecosystem
- Components of block chain
- Overview of Consensus Mechanisms
- Cryptocurrency, Digital Currency Bitcoin and Ethereum
- Introduction to Smart Contracts
- Blockchain use cases

Chapter 2	Cryptography	8 Lectures

1. Introduction to Cryptography:
   - Definition and importance of cryptography
   - Historical overview of cryptography
2. Modern Cryptography:
   - Block ciphers (e.g., DES, AES)
   - Stream ciphers
   - Public-key cryptography (e.g., RSA)

- Elliptic Curve Cryptography (ECC)

Cryptographic Hash Functions(SHA256 Hash):

- Understanding SHA256 Hash
- Properties of hash functions
- Applications of hash functions (e.g., in digital signatures)

3. Digital Signatures:

- Concept of digital signatures, structure, process
- Applications in authentication and integrity verification

4. Cryptanalysis:

- Methods of attacking cryptographic systems
- Brute-force attacks, frequency analysis, etc.

Chapter 3	How Block chain Works?	5 Lectures

- Understanding SHA256 Hash
- Immutable Ledger
- Distributed P2P Network
- How Mining Works? (The NONCE and Cryptographic Puzzle)
- Byzantine Fault Tolerance
- Consensus Protocols: Proof of Work, Proof of State, Défense Against Attackers, Competing Chains
- Blockchain Demo

Chapter 4	Smart Contracts	6 Lectures

- Ethereum Network
- What is a Smart Contract?
- Ethereum Virtual Machine, Ether, Gas
- DApps
- Decentralized Autonomous Organizations (DAO)
- Hard and Soft Forks
- Initial Coin Offerings
- Demo of Smart Contracts

Demonstration	Programming Assignments:	5 Lectures

Teacher should give demonstration of various programs mentioned below in the classroom or in the laboratory as per their convenience.

Assignment 1 –Demonstration of Blockchain
https://andersbrownworth.com/blockchain

Assignment 2 – Write a Simple Python program to create a Block class that contains index, timestamp, and previous hash. Connect the blocks to create a Blockchain.

Assignment 3 –Write a Simple Python program to create a Block class that contains index, timestamp, and previous hash. Connect the blocks to create a Blockchain.

Assignment 4 –Demo of Remix-Ethereum IDE https://remix.ethereum.org and Test Networks

Assignment5–1. Write a Simple Smart Contract for Bank with withdraw and deposit functionality.

Assignment 6 – 2. Write a Smart Contract for storing and retrieving information of Degree Certificates.

Reference Books:

Textbook:

1. Beginning Blockchain : A Beginner's Guide to Building Blockchain Solutions By Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress Media

Reference Books:

2. Mastering Blockchain by Imran Bashir, Third Edition, Packt Publication
3. Waterhole, The Science of the Blockchain
4. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
5. Mastering Ethereum: Building Smart Contracts and DAPPS, by Andreas Antonopoulos, Dr.Gavid Wood, Oreilly Publication

Reference Web Links

1. https://www.investopedia.com/terms/b/blockchain.asp

Savitribai Phule Pune University
T.Y.B.Sc. (Information Technology)
IT-368
Title: Emerging Technologies

Teaching Scheme	No. of Credits	Examination Scheme
3 hours / week	2	CA: 15 marks UA: 35 marks

Prerequisites

1. Fundamental concepts of computers

Course Objectives: -

- By the end of this course, students should be able to:
  1. Explain the importance of managing technological innovation strategically.
  2. Develop leadership skills for planning, organizing, directing and implementing innovation.

Course Outcomes: - Student will be able to: -

1. Identify and analyze various emerging technologies.
2. Understand the impact of emerging technologies in a global context.
3. Understand the impact of emerging technologies on society as a whole.

Course Contents

Chapter 1	**Introduction to Emerging Technologies**	**5 hours**

1.1 Introduction to Emerging Technologies, Evolution of Technologies, Role of data emerging technologies.
1.2 Enabling devices and networks for emerging technologies
1.3 Human-to-machine interaction, futures trends in emerging technologies

Chapter 2	**Augmented Reality (AR) and Virtual Reality (VR)**	**10 hours**

2.1 Introduction to Virtual Reality, Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality
2.2 What Is Augmented Reality - Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies - Media, Technologies, Other Ideas Related to the Spectrum Between Real and Virtual Worlds, applications of augmented reality Augmented Reality
2.3 Concepts - How Does Augmented Reality Work? Concepts Related to Augmented Reality, Components of an Augmented Reality Experience.

Chapter 3	The Hadoop Ecosystem	5 hours
3.1 The Hadoop Ecosystem Introduction to Hadoop, Hadoop Architecture, History of Hadoop- Facebook, Dynamo, Yahoo, Google 3.2 Hadoop Components : HDFS, Mapreduce Hadoop Architecture Data Storage in Hadoop 3.3 Tools available in Hadoop Ecosystem (Hive, pig, HBase)		
Chapter 4	**Introduction to Cloud Computing**	**5 hours**
4.1 Introduction to Cloud Computing, Recent Trends in Computing Cloud Computing, Evolution of cloud computing. Cloud Computing Architecture 4.2 Cloud Computing Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (Saas) 4.3 Data Management in Cloud Computing, Resource Management in Cloud Computing, Cloud Implementation.		
Chapter 5	**Introduction to Edge Computing**	**5 hours**
5.1 Introduction to Edge Computing Architectures. 5.2 Edge Computing to support User Applications (5G-Slicing, self-driving cars and more)		

Reference Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009. 2.
2. Gerard Jounghyun Kim, Designing Virtual Systems: The Structured Approach, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, 3D User Interfaces, Theory and Practice, Addison Wesley, USA, 2005
4. Data Analytics with Hadoop - An Introduction for Data Scientists by Benjamin Bengfort and Jenny Kim.