Shrimathi Devkunvar Nanalal Bhatt Vaishnav College For Women (Autonomous)

Re-Accredited with 'A+' Grade By NAAC.
Chromepet, Chennai-600044.

Department of Computer Science with Data Science

Framework & Syllabus for the batch admitted 2022-2025

Branch –B.Sc COMPUTER SCIENCE.

UG

CHOICE BASED CREDIT SYSTEM (CBCS)
OUTCOME BASED EDUCATION (OBE)

RULES AND REGULATIONS

B.SC. COMPUTER SCIENCE WITH DATA SCIENCE
(Shift – II)
Under the faculty of Science

OBJECIVES OF THE COURSE:

This course is designed to achieve a high degree of technical skills in Problem solving and Modern application development. The course develops requisite professional skills and problem solving along with developing the analytical abilities for pursuing a successful career in software industry and forms the required basics for further higher studies in Computer Science specifically in the area of Data Science.

UG REGULATIONS

1. **ELIGIBILITY FOR ADMISSION**:

    Candidates for admission to the first year of the Degree of Bachelor of Science in Computer Science with Data Science Courses should have studied Mathematics at Higher Secondary level.

2. **ELIGIBILITY FOR THE AWARD OF DEGREE**:

    A candidate shall be eligible for the award of the degree only if she has undergone the prescribed course of the study in a college affiliated to the university for a period of not less than three academic years, passed the examinations all the Six-Semesters prescribed earning 140 Credits (in parts-I,II,III,IV&V)

3. **DURATION:**

    1. Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixth semester respectively.

    2. The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

4. **COURSE OF STUDY**:

The main subject of study for Bachelor Degree Courses shall consists of the following :

    PART – I   TAMIL/OTHER LANGUAGES(Hindi/Sanskrit/French)

    PART – II   ENGLISH

    PART – III   CORE SUBJECTS, ALLIED SUBJECTS, PROJECT/ ELECTIVES

    PART- IV

1. NON- MAJOR ELECTIVES

    i. Those who have not studied Tamil up to XII Std. and taken a Non- Tamil Language under Part-I shall take Tamil comprising of two course(level will be at 6th Standard).

    ii. Those who have studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses.

    iii. Others who do not come under a & b can choose Non-Major elective comprising of two courses.

2. SKILL BASED SUBJECT (Four) – (2 SOFT SKILLS + 1 skill based elective related to the subject +1 Computing skill)

3. ENVIRONMENTAL STUDIES

4. VALUE EDUCATION – Yoga and Health

    PART–V

    EXTENSION ACTIVITIES (SPORTS/NCC/NSS/ROTARACT)

    PART–VI

    EXTRA-CURRICULAR AND CO-CURRICULAR ACTIVITIES

                      (Introduced From 2018 onwards)

RECOMMEDED CREDIT DISTRIBUTION

The Minimum Credit Points for UG (Three Year Program)

Particulars	Credits
1. Part I, II,III – (Language/English/Core/Allied)	119
2. Part IV	20
a. Basic Tamil/Advanced Tamil/ Non-major (I & II Sem.)	4
b. Soft Skill (one paper per semester for 4 semesters)	12
c. EVS(III Semester)	2
d. Value Education (VI Sem.)	2
Total (Part I,II,III,IV)	139
Part V Extension Activities	
a. Sports credit for all, (or)Credits to international, national and state players	1-5
b. NCC,NSS,EDP, Consumer club	1-3
Total (PART I,II,III,IV,V)	140-144

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Under graduates of various disciplines would be fully equipped

- To life-long learning in order to become effective collaborators and innovators, leading or participating in ventures thataddress social, technical and business challenges.

- To transform learners into holistic individuals acquiring higher levels of knowledge and competence.

- To approach life skills which are inclusive and value-based to appreciate human values and ethics.

PROGRAMME OUTCOMES (POs)

After completion of the programme, the student will be able to

PO 1 - Develop sharp cognisance of concepts, apply the domain knowledge with utmost confidence and be assertive at any givenopportunity.

PO 2 - Possess deeper understanding of life skills to appraise life and draw logical conclusions.

PO 3 - Design and develop solutions for challenging problems of society.

PO 4 - Acquire programme centric thought process facilitating further studies in the respective domain.

PO 5 - Engage in life-long learning to easily adapt to the dynamic environment and obtain clarity and preparedness for fieldspecialisation

PO 6 - Self actualise and self regulate, focussing on ethical and moral values to become a compassionate human being.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1- Understand the basic principles and concepts of Computer Science and Data Science with an integrated knowledge gained in the domain with practical needs of the society and be an ethically and socially responsible professional.

PSO2- Explore latest emerging technologies in diverse areas of Computer Science and inculcate skills for successful career, entrepreneurship and higher studies.

PSO3- Apply the concepts of Computer and practices via emerging technologies and software development tools to solve pragmatic social concerns.

PSO4- Obtain the knowledge and understanding of systems, various programming languages and tools required for effective computation based problem solving and analysis.

PSO5- Be skilled in acquiring, querying and understanding the basic properties of data, analysis, how to extract insights from data and how to report the results.

PSO6- Be able to use and understand classical and modern data-analytics techniques, statistical machine learning and artificial intelligence techniques.

PSO7- Acquire transferable skills in some or all of: presentations, library and internet research, report writing, information technology (IT) expertise and the use of statistical software.

Framework of Syllabus for 2022-25

Year / Semester	Subject	Subject Code	Title of the Paper	Credits	CIA	ESE	Total
I YEAR I SEMESTER	Core Major I	22UDSCT1001	Introduction to Data Science	4	25	75	100
	Core Practical I	22UDSCP1001	Data Science using Python Lab	3	40	60	100
	Allied Theory I	22UDSAT1001	Allied Mathematics-I	5	25	75	100
			TOTAL(for Major only)	**7**			**200**
I YEAR II SEMESTER	Core Major II	22UDSCT2002	Java and Data Structures	4	25	75	100
	Core Practical II	22UDSCP2002	Data Structures using Java Lab	3	40	60	100
	Allied Theory II	22UDSAT2002	Allied Mathematics-II	5	25	75	100
			TOTAL(for Major only)	**7**			**200**
II YEAR III SEMESTER	Core Major III	22UDSCT3003	Relational Database Management System	4	25	75	100
	Core Practical III	22UDSCP3003	PL/SQL Lab	3	40	60	100
	Allied Theory III	22UDSAT3003	Allied Statistics -I	5	25	75	100
			TOTAL(for Major only)	**7**			**200**
II YEAR IV SEMESTER	Core Major IV	22UDSCT4004	Data Analytics	4	25	75	100
	Core Practical IV	22UDSCP4004	Data Analytics Lab	3	40	60	100
	Allied Theory IV	22UDSAT4004	Allied Statistics -II	5	25	75	100
			TOTAL(for Major only)	**7**			**200**
III YEAR V SEMESTER	Core Major V	22UDSCT5005	Operating Systems	4	25	75	100
	Core Major VI	22UDSCT5006	Computer Networks	5	25	75	100
	Core Major VII	22UDSCT5007	Data Visualization	4	25	75	100
	Core Practical V	22UDSCP5005	Data Visualization Lab	3	40	60	100
	Elective Theory-I	22UDSET5NL1/ 22UDSET5ML1/ 22UDSET5RL1	Choose any one from the list	5	40	60	100
	Elective Practical-I	22UDSEP5001	Elective Lab-I	3	25	75	100
			TOTAL(for Major only)	**24**			**600**

III YEAR VI SEMESTER	Core Major VIII	22UDSCT6008	Cloud Computing	4	25	75	100
	Core Major IX	22UDSCT6009	Internet Of Things	5	25	75	100
	Core Major X	22UDSCT6010	Machine Learning	4	25	75	100
	Core Practical VI	22UDSCP6006	Machine Learning Lab	3	40	60	100
	Elective Theory-II	22UDSET6IS2/ 22UDSET6NS2/ 22UDSET6BT2	Choose any one from the list	5	25	75	100
	Elective Project - I	22UDSPR6001	Mini Project	5	25	75	100
			TOTAL(for Major only)	**26**			**600**

Core Electives

To be offered in V semester

1. Natural Language processing + Lab

2. Mobile Application Development for Machine Learning + Lab

3. Introduction to Reinforcement Learning + Lab

To be offered in VI semester

4. Information Security

5. Network Security

6. Block chain Technology

Detailed Syllabus

I Semester

Title of the Course/Paper	CORE I : INTRODUCTION TO DATA SCIENCE				
Core Thoery I	Year I	Semester I	Subject Code 22UDSCT1001	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Understand the significance of data, its types and the evaluation of data and also understand the key characteristics of Big Data
CO2	Demonstrate the basic concepts of variables ,expressions and Illustrate the concept of functions and control structures
CO3	Acquire knowledge about various special data formats and its related methods
CO4	Analyse the characteristics of Numpy and Pandas libraries and illustrate how to load, manage, and explore data from datasets .
CO5	Demonstrate the techniques for effective visualization and presentation of data.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs \ COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weakly Correlated-1 No Correlation-0

Course Average : 3

UNIT – I   Data Types: Understanding data - Types of data - Data Evaluation - Data Sources - Preparing and Gathering data- Digital Data - Introduction to Big Data - Sources of Big Data - Characteristics of Big Data

UNIT – II   Python fundamentals : Python program execution environment - Statements - Expressions - Flow of Controlstatements - Functions - Scope of Variables .

UNIT – III   Special Data Formats - List - List Methods - Tuples - Tuple Methods - Arrays - Dictionaries - Sets – RelatedMethods - String - String Processing Methods

UNIT – IV   Numpy and Pandas - Features of Numpy - Mathematical functions - Statistical functions - nd-Arrays – Featuresof Pandas - series data structure - data frames - creation and manipulation of data frames

UNIT – V   Data Visualization - Matplotlib package - plotting graphs - legends - colors - labels - seaborn - package –plotlyand dash packages

Books for Study	1.	Joel grus, "Data Science from Scratch", O'Reilly,2
	2.	Mark Lutz, " Programming in Python", O'Reilly,2010
Books for Reference	1.	Wes Mckinney, "Python for data Analysis", O'Reilly,2012
	2.	Shai vaingast,"Beginning Python on visualization", A Press 2014

Web References	1.	NPTEL online course– Data Science for Engineers - https://nptel.ac.in/courses/106106179/
	2.	https://www.javatpoint.com/python-tutorial
	3.	https://www.w3schools.com/python/
	4.	https://www.programiz.com/python-programming

Title of the Course/Paper	CORE PRACTICAL I : DATA SCIENCE USING PYTHON LAB					
Core Practical I	Year I	Semester I	Subject Code 22UDSCP1001	Credits 3	Hours	

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Demonstrate proficiency in handling of loops and creation of functions.
CO2	Identify the methods to create and manipulate lists, tuples,and dictionaries and also perform string manipulations.
CO3	Interpret the concepts of Object-Oriented Programming as used in Python
CO4	Discover the commonly used operations involving regular expressions, file system and merging datasets. Implement aggregation and grouping operations on datasets.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
Average	3	3	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 3

LIST OF EXERCISES:

1. Editing and executing Programs involving Flow Controls.

2. Editing and executing Programs involving Functions.

3. Program in String Manipulations

4. Creating and manipulating a Tuple

5. Creating and manipulating a List

6. Creating and manipulating a Dictionary

7. Object Creation and Usage

8. Program involving Inheritance

9. Program involving Overloading

10. Reading and Writing with Text Files and Binary Files

11. Combining and Merging Data Sets

12. Program involving Regular Expressions

13. Data Aggregation and GroupWise Operations

<table>
<tr><td rowspan="6">Books
for
References</td><td>1.</td><td>Python Crash Course, 2nd Edition, By Eric Matthes, May 2019</td></tr>
<tr><td>2.</td><td>NumPy Essentials, By Leo Chin and Tanmay Dutta, April 2016</td></tr>
<tr><td>3.</td><td>Joel Grus, "Data Science from scratch", O'Reilly, 2015.</td></tr>
<tr><td>4.</td><td>Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012.</td></tr>
<tr><td>5.</td><td>Kenneth A. Lambert, (2011), "The Fundamentals of Python: First Programs", Cengage Learning</td></tr>
<tr><td>6.</td><td>Jake Vanderplas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition.</td></tr>
</table>

Title of the Course/Paper	CORE I : JAVA AND DATA STRUCTURE				
Core Thoery II	Year I	Semester II	Subject Code 22UDSCT2002	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Understand the basic concepts of Java programming and its significance of operators and control statements
CO2	Describe the fundamentals of object-oriented programming including defining classes, objects, invoking methods to create applications
CO3	Acquire knowledge about interfaces, packages, multithreading and exceptions
CO4	Recognize the implementation of lists, stacks ,queue and their use in algorithms
CO5	Demonstrate the representation of trees and graph data structures

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	2	2	2	3
CO2	3	3	3	2	3	3	3
CO3	3	3	3	2	3	3	3
CO4	3	3	3	2	3	3	3
CO5	3	3	3	2	3	3	3
Average	3	3	2.8	2	2.8	2.8	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average: 2.771

UNIT – I   History and Evolution of Java - Features of Java - Object Oriented Concepts – Bytecode - Lexical Issues - Data Types – Variables- Type Conversion and Casting- Operators - Arithmetic Operators - Bitwise - Relational Operators - Assignment Operator - The conditional Operator - Operator Precedence- Control Statements – Arrays.

UNIT – II   Classes - Objects - Constructors - Overloading method - Static and fixed methods - Inner Classes – String Class- Overriding methods - Using super-Abstract class - this keyword – finalize() method – Garbage Collection.

UNIT – III   Packages - Access Protection - Importing Packages - Interfaces - Exception Handling - Throw and Throws- The Java Thread Model- Creating a Thread and Multiple Threads - Thread Priorities Synchronization-Interthread Communication – Deadlock - Suspending, Resuming and stopping threads – Multithreading-I/O Streams - File Streams - Applets .

UNIT – IV   Abstract Data Types(ADTs)-List ADT-Array based implementation-linked list implementation-singly linked list-doubly linked list-circular linked list-Stack ADT operations-Applications-Evaluating arithmetic expressions-Conversion of infix to postfix expression-Queue ADT-operations-Applications of Queues.

UNIT – V   Trees-Binary Trees- representation - Operations on Binary Trees- Traversal of a Binary Tree -Binary Search Trees, Graphs- Representation of Graphs - Traversal in Graph -Dijkstra's Algorithm, Depth-First vs Breadth- First Search.

Books for Study	1.	E.Balagurusamy," Programming with Java: A Primer", Tata McGraw Hill 2014, 5th Edition.
	2.	Mark Allen Weiss, "Data Structures and Algorithms Analysis in C++", Person Education 2014, 4 th Edition.
Books for Reference	1.	Herbert Schildt, "JAVA 2: The Complete Reference", McGraw Hill 2018, 11th Edition.
	2.	Aho, Hopcroft and Ullman, "Data Structures and Algorithms ", Pearson Education 2003.
	3.	S. Sahni, "Data Structures, Algorithms and Applications in JAVA", Universities Press 2005, 2 nd Edition

Web References	1.	NPTEL & MOOC courses titled Java and Data Structures https://nptel.ac.in/courses/106105191/ https://nptel.ac.in/courses/106106127/
	2.	https://www.geeksforgeeks.org/data-structures/
	3.	https://www.w3schools.com/java/

Title of the Course/Paper	CORE I : DATA STRUCTURES USING JAVA LAB				
Core Practical II	Year I	Semester II	Subject Code 22UDSCP2002	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Implement linear and non-linear data structure operations.
CO2	Understand the different operations of search trees
CO3	Implement graph traversal algorithm

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
Average	3	3	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 3

LIST OF EXERCISES:

1. Write a Java program to implement the Stack ADT using a singly linked list.

2. Write a Java program to implement the Queue ADT using a singly linked list.

3. Write a Java program for the implementation of circular Queue.

4. Write a Java program that reads an infix expression, converts into postfix form

5. Write a Java program to evaluate the postfix expression (use stack ADT).

6. Write a Java program to Insert an element into a binary search tree.

7. Write a Java program to delete an element from a binary search tree.

8. Write a Java program to search for a key element in a binary search tree.

9. Write a Java program for the implementation of BFS for a given graph.

10. Write a Java program for the implementation of DFS for a given graph

Web References	1.	https://www.geeksforgeeks.org/
	2.	https://www.tutorialspoint.com/
	3.	https://www.javatpoint.com/data-structure
	4.	https://www.programiz.com/java-programming
	5.	https://prepinsta.com/data-structures/

Title of the Course/Paper	CORE III : RELATIONAL DATABASE MANAGEMENT SYSTEM				
Core Thoery III	Year II	Semester III	Subject Code 22UDSCT3003	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Describe the concepts of database technologies, Model Entity Relationship with E-R diagrams and the classification of ER model.
CO2	Be familiar with the relational database theory according to Codd's rules, and be able to write relational algebra expressions and calculus for queries.
CO3	Design database schema considering normalization and relationships within database and also can summarize the transaction processing mechanisms.
CO4	Be able to write SQL commands for data definition and data manipulation in query processing.
CO5	Develop triggers, procedures, user defined functions, packages and design PLSQL Programs.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs \ COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	2	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	2.8	2.8	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average 2.943

UNIT - I

Introduction to DBMS– Data and Information - Database – Database Management System – Objectives - Advantages – Components - Architecture. ER Model: Building blocks of ER Diagram – Relationship Degree – Classification – ER diagram to Tables – ISA relationship – Constraints – Aggregation and Composition – Advantages

UNIT - II

Relational Model: CODD's Rule- Relational Data Model - Key - Integrity – Relational Algebra Operations – Advantages and limitations – Relational Calculus – Domain Relational Calculus - QBE.

UNIT - III

Structure of Relational Database. Introduction to Relational Database Design - Objectives – Tools – Redundancy and Data Anomaly – Functional Dependency - Normalization – 1NF – 2NF – 3NF – BCNF. Transaction Processing – Database Security.

UNIT - IV

SQL: Commands – Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery.

UNIT - V

PL/SQL: Structure - Elements – Operators Precedence – Control Structure – Iterative Control - Cursors – Procedure - Function - Packages – Exceptional Handling - Triggers.

Books for Study	1.	S. Sumathi, S. Esakkirajan, "*Fundamentals of Relational Database Management System*", Springer International Edition 2007.
Books for Reference	1.	Abraham Silberchatz, Henry F. Korth, S. Sudarshan, "*Database System Concepts*", McGrawHill 2019, 7th Edition.
	2.	Alexis Leon & Mathews Leon, "*Fundamentals of DBMS*", Vijay Nicole Publications 2014, 2nd Edition.

Web References	1.	NPTEL & MOOC courses titled Relational Database Management Systems https://nptel.ac.in/courses/106106093/ https://nptel.ac.in/courses/106106095/
	2.	https://www.geeksforgeeks.org/
	3.	https://www.w3schools.com/sql /

Title of the Course/Paper	Core Practical III : PL/SQL LAB					
Core Practical III	Year II	Semester III	Subject Code 22UDSCP3003	Credits 3	Hours	

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Implement the DDL, DML Commands and Constraints.
CO2	Implement queries, sub queries and using aggregate functions to retrieve information from database.
CO3	Develop PL/SQL block for exception handling, cursors, packages and triggers.
CO4	Design and develop simple database applications.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	1	2
CO2	3	3	2	3	3	1	2.5
CO3	3	3	2	3	3	1	2
CO4	3	3	3	3	3	1	2
Average	3	3	2.25	3	3	1	2.125

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average 2.48

LIST OF EXERCISES

1) DDL commands with constraints.
2) DML Commands with constraints.
3) SQL Queries: Queries, sub queries, Aggregate function
4) PL/SQL : Exceptional Handling
5) PL/SQL : Cursor
6) PL/SQL : Trigger
7) PL/SQL : Packages
8) Design and Develop Application for Library Management
9) Design and Develop Application for Student Mark Sheet Processing
10) Design and Develop Application for PayRoll Processing

Title of the Course/Paper	CORE IV : DATA ANALYTICS				
Core Theory IV	Year II	Semester IV	Subject Code 22UDSCT4004	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To introduce the concepts of Big Data and to handle missing data in the real world data sets by choosing appropriate methods.
CO2	To summarize the data using basic statistics and visualize the data using basic graphs and plots.
CO3	To apply exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.
CO4	To identify the outliers if any in the data set and choose appropriate feature selection and dimensionality reduction for data pre-processing.
CO5	To develop and evaluate model using predictive analytics and data visualization.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	2	3	2	2.5
CO2	3	3	3	3	3	3	2
CO3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	2.8	2.8	3	2.8	2.7

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average 2.871

UNIT I : Introduction:

Big Data - Characteristics of Big Data - Types of Data: Structured, Unstructured and Semi structured - Measurement Scales: Nominal, Ordinal, Interval scale and ratio - Scope of Exploratory Data Analysis-Steps involved in Exploratory Data Analysis.

UNIT II : Univariate Graphical and Statistical Analysis:

Bar chart, Pie chart, Histogram, Stem and leaf plot, Box Whisker Plot-Measures of Averages, Mean, Median and Mode- Measures of dispersion, Range, Mean Deviation, Quartile Deviation, Standard deviation and variance-Skewness and Kurtosis.

UNIT III : Bivariate Graphical and Statistical Analysis:

Scatter Plot- Covariance and Correlation Coefficient-Assumptions-Karl Pearson's correlation coefficient-Spearman's Correlation coefficient- Regression coefficients and fitting of Regression lines.

UNIT IV : Data Pre-processing:

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning: Dealing with missing values and outliers – Data Integration and Transformation – Data Reduction – Data Discretization.

UNIT V : Model Development:

Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot –Measures for In-sample Evaluation –Over fitting and Cross Validation-Prediction and Decision Making.

Books for Study	1.	John Tukey, "Exploratory Data Analysis", Addison-Wesley Series,2019.
	2.	Gupta. S.C. & Kapoor,V.K. , Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd. New Delhi,2002.
	3.	Suresh Kumar Mukhiya and Usman Ahmed," Exploratory Data Analysis with Python", PACKT, 2020.
Books for Reference	1.	Dr Anil Maheshwari, Data Analytics Made Accessible, Publisher: Amazon.com Services LLC.
	2.	Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 1st edition, 2015.
	3.	Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O' Reilly, 1st edition, 2013.
	4.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2nd edition, 2014.
	5.	Eric Siegel, Predictive Analytics The Power to Predict Who Will Click, Buy, Lie, or Die,2nd Ed., Wiley.

Web References	1.	https://flowingdata.com/
	2.	https://www.analyticsvidhya.com/
	3.	https://www.r-bloggers.com/
	4.	https://www.datasciencecentral.com/

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Title of the Course/Paper	Core Practical IV : DATA ANALYTICS LAB				
Core Practical IV	Year II	Semester IV	Subject Code 22UDSCP4004	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	Understand and use python data science libraries as a tool for data analytics.
CO2	Create visualizations for the statistical results using python.
CO3	Handle preprocessing and the transformation of data.
CO4	Generate regression models and correlation analysis.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	3	2.5
CO2	3	3	2	3	3	3	2.5
CO3	3	3	2	3	3	3	2.5
CO4	3	3	2	3	3	3	2.5
Average	3	3	2	3	3	3	2.5

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average 2.785

LAB EXERCISES:

GENERATING UNIVARIATE & BIVARIATE PLOTS

1. BAR CHART
2. PIE CHART
3. HISTOGRAM
4. STEM AND LEAF PLOT
5. BOX-WHISKER PLOT
6. SCATTER DIAGRAM
7. HEAT MAPS

SUMMARY STATISTICS

8. MEAN, MEDIAN AND MODE
9. STANDARD DEVIATION
10. SKEWNESS AND KURTOSIS

DATA PREPROCESSING

11. IMPUTATION OF MISSING VALUES
12. CODING CATEGORICAL VARIABLES
13. DATA TRANSFORMATION AND DISCRETIZATION

GENERATING MODELS

14. CORRELATION ANALYSIS
15. REGRESSION MODELS WITH EVALUATION METRICS-R SQUARE, MSE, RMSE

Title of the Course/Paper	CORE V : OPERATING SYSTEM				
Core Theory V	Year III	Semester V	Subject Code 22UDSCT5005	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the basic concepts, Structure and Services of Operating System
CO2	To describe about the process synchronization techniques and identify deadlocks for prevention, avoidance, detection and recovery
CO3	To analyse the memory management techniques and discuss the differentiate between Contiguous and Non contiguous memory
CO4	To recognize the techniques of paging replacement algorithms and File system management
CO5	To demonstrate I/O Hardware functions and User Authentication.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	2	3	2	2.5
CO2	3	3	3	3	3	3	2
CO3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	2.8	2.8	3	2.8	2.7

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.871

UNIT - I

Introduction: Views - Types of System - OS Structure – Operations - Services – Interface- System Calls- System Structure - System Design and Implementation. Process Management: Process - Process Scheduling - Inter-process Communication. CPU Scheduling: CPU Schedulers - Scheduling Criteria - Scheduling Algorithms.

UNIT - II

Process Synchronization: Critical- Section Problem - Synchronization Hardware Semaphores - Classical Problems of Synchronization - Monitors. Deadlocks: Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Avoidance - Detection - Recovery.

UNIT - III

Memory Management: Hardware - Address Binding – Address Space - Dynamic Loading and Linking – Swapping – Contiguous Allocation - Segmentation - Paging – Structure of the Page Table.

UNIT - IV

Virtual Memory Management: Demand Paging - Page Replacement Algorithms - Thrashing. File System: File Concept -. Access Methods - Directory and Disk Structure - Protection - File System Structures - Allocation Methods - Free Space Management.

UNIT - V

I/O Systems: Overview - I/O Hardware - Application I/O Interface - Kernel I/O Subsystem - Transforming 1/0 Requests to Hardware Operations - Performance. System Protection: Goals - Domain - Access matrix. System Security: The Security Problem - Threats – Encryption- User Authentication.

Books for Study	1.	Abraham Silberschatz, Peter B Galvin, Greg Gagne, "*Operating System Concepts*", Wiley India Pvt. Ltd 2018, 9th Edition,.
Books for Reference	1.	William Stallings, "*Operating Systems Internals and Design Principles*", Pearson, 2018, 9th Edition.
	2.	Andrew S. Tanenbaum, Herbert Bos, "*Modern Operating Systems*", Pearson 2014, 4th Edition.

Web References	1.	NPTEL & MOOC courses titled Operating Systems https://nptel.ac.in/courses/106106144/

Title of the Course/Paper	CORE VI : COMPUTER NETWORKS					
Core Theory VI	Year III	Semester V	Subject Code 22UDSCT5006	Credits 5	Hours	

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the basic concepts Network Hardware and Software, OSI reference model, services and role of each layer of OSI model
CO2	To describe about the Wireless transmission, Multiplexing, Switching networks.
CO3	To analyse the Channel Allocation problem, multiple access protocol in Data Link layer
CO4	To explain the functions of routing and congestion control algorithms.
CO5	To demonstrate the functions of Transport layer services in Connection management, Network security and Cryptography

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 3

UNIT - I

Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.

UNIT - II

Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues - Error Detection and Correction.

UNIT - III

Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer - Channel Allocation Problem - Multiple Access Protocols - Bluetooth.

UNIT - IV

Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols.

UNIT - V

Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography.

Books for Study	1.	A. S. Tanenbaum, "*Computer Networks*", Prentice-Hall of India 2008, 4th Edition.
Books for Reference	1.	Stallings, "*Data and Computer Communications*", Pearson Education 2012, 7th Edition.
	2.	B. A. Forouzan, "*Data Communications and Networking*", Tata McGraw Hill 2007, 4th Edition.
	3.	F. Halsall, "*Data Communications, Computer Networks and Open Systems*", Pearson Education 2008.
	4.	D. Bertsekas and R. Gallagher, "*Data Networks*", PHI 2008, 2nd Edition.
	5.	Lamarca, "*Communication Networks*", Tata McGraw Hill 2002.

Web References	1.	NPTEL & MOOC courses titled Computer Networks https://nptel.ac.in/courses/106106091/

Title of the Course/Paper	CORE VII : DATA VISUALIZATION				
Core Theory VII	Year III	Semester V	Subject Code 22UDSCT5007	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To explore design and create data visualizations based on data available data modeling, data processing.
CO2	To conduct exploratory data analysis using visualization by mapping data attributes to graphical attributes
CO3	To learn to evaluate the effectiveness of visualization designs, and think critically about each design decision
CO4	To use knowledge of perception and cognition to evaluate visualization design alternatives.
CO5	To create their own data visualizations, and learn to use Python visualization tools.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs \ COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.971

UNIT I: INTRODUCTION TABLEAU

Introduction to Tableau: Advantages of Tableau Analytics Platform, Data Preparation Tableau workspace, Working with measures and dimensions. Data types - Data collection - Setting up a Data Connector - Selecting Data Tables – Joins – Unions - Data extracts and live connections - Editing the model's metadata.

UNIT II: CREATING BASIC DATA VISUALIZATIONS

Creating Charts - Chart types -Bar Charts, Legends, Filters and Hierarchies - Line Charts - Highlight Tables - Heat Maps - Bullet Charts - Cumulative Sums with Waterfall Charts.

UNIT III: CREATING ADVANCED DATA VISUALIZATIONS

Aggregate Functions - Calculated Fields - Aggregations in Calculated Fields - Text Operator - Data fields - Logical functions – Parameters - Types of calculations - Quick Table calculations - Level of detailed expression.

UNIT IV: CREATING MAPS

Creating Symbol Maps - Filled Maps - Density Maps - Map Layers - Maps embedded with Pie Charts.

UNIT V: CREATING INTERACTIVE DASHBOARDS

Creating a Dashboard - Dashboard Title - Navigation Buttons - Dashboard Actions - Templates for visualizing Cloud data.

Books for Study	1.	Claus O. Wilke, "Fundamentals of Data Visualization", O'Reilly, 2019.
Books for Reference	1.	Alexander Loth, "Visual Analytics with Tableau", Wiley, 2019.
	2.	Davy Cielen, Arno D. B. Meysman and Mohamed Ali, "Introducing Data Science",Manning Publications, 2016.
	3.	D J Patil, Hilary Mason & Mike Loukides, Ethics and Data Science, O' Reilly, 2018.

Web References	1.	https://www.tableau.com/sites/default/files/media/designinggreat-visualizations.pdf
	2.	https://flowingdata.com/2017/01/24/one-dataset-visualized-25-ways/
	3.	https://www.tableau.com/learn/tutorials/ondemand/gettingstarted?playlist=554268&signin=4bec05bc7a876b95af7722b08fff9224
	4.	https://public.tableau.com/en-us/s/resources

Title of the Course/Paper	Core V : DATA VISUALIZATION - LAB				
Core Practical V	Year III	Semester V	Subject Code 22UDSCP5005	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the main concepts of data visualization
CO2	To create several different charts using Tableau
CO3	To recognize good (and bad) data visualizations and to use shapes, colors, text and layout appropriately for visualization
CO4	To create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
Average	3	2.7	3	3	3	3	2.7

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

LIST OF EXERCISES:

1. Working with Data Types and Data Connector
2. Working with Tables: Joins, Unions, Data Extracts
3. Building Bar Charts with Legends, Filters and Hierarchies
4. Line Charts
5. Heat Maps
6. Bullet Charts
7. Waterfall Charts.
8. Working with Aggregate Functions
9. Working with Logical Functions
10. Creating Symbol Maps
11. Creating Filled Maps
12. Creating Density Maps
13. Constructing Maps embedded with Pie Charts
14. Creating a Dashboard with Title and Navigation Buttons
15. Working with Dashboard Actions
16. Visualizing Cloud data

BOOKS	**1.**	Claus O. Wilke, "Fundamentals of Data Visualization", O'Reilly, 2019.
	2.	Alexander Loth, "Visual Analytics with Tableau", Wiley, 2019.
	3.	Davy Cielen, Arno D. B. Meysman and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
	4.	D J Patil, Hilary Mason & Mike Loukides, Ethics and Data Science, O' Reilly, 2018.

Title of the Course/Paper	Elective Theory-I : NATURAL LANGUAGE PROCESSING				
Elective Theory I	Year III	Semester V	Subject Code 22UDSET5NL1	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the fundamental concepts and techniques of natural language processing
CO2	To map the appropriate processing technique to a problem and implement the technique.
CO3	To distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each.
CO4	To use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.
CO5	To analyze large volume text data generated from a range of real-world applications.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	2	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	2.8	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

UNIT – I: INTRODUCTION

Overview: Origins and challenges of NLP- Theory of Language -Features of Indian Languages – Issues in Font –Models and Algorithms- NLP Applications.

UNIT II - MORPHOLOGY AND PARTS-OF-SPEECH

Phonology – Computational Phonology - Words and Morphemes – Segmentation – Categorization and Lemmatisation – Word Form Recognition – Valency - Agreement - Regular Expressions – Finite State Automata – Morphology- Morphological issues of Indian Languages – Transliteration.

UNIT III - PROBABILISTIC MODELS

Probabilistic Models of Pronunciation and Spelling – Weighted Automata – N- Grams – Corpus Analysis – Smoothing – Entropy - Parts-of-Speech – Taggers – Rule based – Hidden Markov Models – Speech Recognition.

UNIT IV - SYNTAX

Basic Concepts of Syntax – Parsing Techniques – General Grammar rules for Indian Languages – Context Free Grammar – Parsing with Context Free Grammars – Top Down Parser – Earley Algorithm – Features and Unification - Lexicalised and Probabilistic Parsing.

UNIT V - SEMANTICS AND PRAGMATICS (6 hours) Representing Meaning – Computational

Representation – Meaning Structure of Language – Semantic Analysis – Lexical Semantics – WordNet – Pragmatics – Discourse – Reference Resolution – Text Coherence – Dialogue Conversational Agents.

Books for Study	1.	Ronald Hausser, "Foundations of Computational Linguistics", Springer-Verleg, 1999.
Books for Reference	2.	Daniel Jurafskey and James H. Martin "Speech and Language Processing", Prentice Hall, 2009.
	3.	Christopher D.Manning and Hinrich Schutze, "Foundation of Statistical Natural Language Processing", MIT Press, 1999.
	4.	James Allen, "Natural Language Understanding", Benjamin/Cummings Publishing Co. 1995.
	5.	Applied Natural Language Processing with Python: Implementing Machine Learning and Deep Learning Algorithms for Natural Language Processing,By Taweh Beysolow II, September 2018

Web References	1.	https://blog.algorithmia.com/introduction-natural-language-processingnlp/
	2.	https://www.udacity.com/course/natural-language-processingnanodegree--nd892. https://www.coursera.org/learn/language-processing
	3.	https://towardsdatascience.com/a-practitioners-guide-to-naturallanguage-processing-part-i-processing-understanding-text-9f4abfd13e72
	4.	https://www.edx.org/course/natural-language-processing

Title of the Course/Paper	Elective Theory-I : MOBILE APPLICATION DEVELOPMENT FOR MACHINE LEARNING				
Elective Theory I	Year III	Semester V	Subject Code 22UDSET5ML1	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the Android with Machine Learning
CO2	To analyze the Anatomy of an Android Application Context, Activities, Services, Intents
CO3	To envisage outcomes automatically without human interference
CO4	To learn Machine learning serving mobile application
CO5	To analyze user behavior patterns and suggest apps which will reduce human interference

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	3	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.942

Unit I:

Mobile App Development:

Mobile App Development – Android Platform – Android SDK – Eclipse Installation – Building simple Android Applications.

Unit II:

Android Application Design Essentials:

Anatomy of an Android Application – Android Terminologies: Application Context, Activities, Services, Intents – Receiving and broadcasting Intents – Intent Filters – Content Providers.

Unit III:

 Android User Interface Design Essentials:

User Interface Design Elements – Designing User Interfaces with Layouts – Drawing and working with animation.

Unit IV:

TensorFlow Lite:

Converting a Machine Learning model to TensorFlow Lite – Saving the model – Loading the Model and allocating Tensors – Performing prediction – Optimizing the model.

Unit – V:

TensorFlow Android App Development:

Editing Layout File – Adding TensorFlow Lite dependencies – Adding TensorFlow Lite model – Writing Activity code for getting insights from data - Case Study: Processing Images on a Mobile

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Books for Study	1.	Ryan Cohen and Tao Wang, "GUI Design for Android Apps", Apress, 2014.
	2.	John Horton, "Android Programming for Beginners", Second Edition, Packt, 2018
Books for Reference	1.	Ted Hagos, "Learn Android Studio with Kotlin: Efficient Android App Development", Apress, 2018.
	2.	Laurence Moroney, "AI and ML for Coders", O'Reilly, 2020.
	3.	Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
	4.	Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
	5.	Android Application Development All in one for Dummies by Barry Burd, Edition: I

Web References	1.	http://venturebeat.com/2009/01/01/android-netbooks-on-their-way-likely-by-2010/

Title of the Course/Paper	Elective Theory-I : INTRODUCTION TO REINFORCEMENT LEARNING				
Elective Theory I	Year III	Semester V	Subject Code 22UDSET5RL1	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the statistical learning techniques where an agent explicitly takes actions and interacts with the world.
CO2	To analyze the basic exploration methods and the exploration/exploitation tradeoff
CO3	To understand value functions, as a general-purpose tool for optimal decision-making
CO4	To Know how to implement dynamic programming as an efficient solution approach to an industrial control problem.
CO5	To determine be able to start using RL for real problems,

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	2
CO2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	3	2.4

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.885

Unit – I: Monte-Carlo Methods

Monte-Carlo methods: policy evaluation, rollouts, on policy and off-policy learning, importance sampling

Unit – II: Temporal Difference Learning

Temporal Difference learning: TD prediction, Optimality of TD(0), SARSA, Q-learning, Games and after states, Maximization Bias and Double Learning.

Unit – III: EligibilityTraces

Eligibility traces: n-step TD prediction, TD(lambda), forward and backward views, Q(lambda), SARSA(lambda), replacing traces and accumulating traces.

Unit – IV: Function Approximation

Function Approximation: Value prediction, gradient descent methods, linear function approximation, Control algorithms, Fitted Iterative Methods, Deep Q-learning.

Unit – V: Computer Vision

Policy Gradient methods: non-associative learning - REINFORCE algorithm, exact gradient methods, estimating gradients, approximate policy gradient algorithms, actor-critic methods, Asynchronous Advantage Actor-Critic.

Hierarchical RL: MAXQ framework, Options framework, HAM framework, Option discovery algorithms.

Case studies: Elevator dispatching, Samuel's checker player, TD-gammon, Acrobot, Helicopter piloting, Alpha Go

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Books for Study	1.	R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 2nd Edition. 2018.
	2.	Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
Books for Reference	1.	Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
	2.	Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012)
	3.	Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.
	4.	Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.

Web References	1.	David Silver's course on Reinforcement Learning (link)
	2.	Video Lectures by Prof. David Silver
	3.	Video Lectures by Prof. B.Ravindran

Title of the Course/Paper	Elective Practical-I : NATURAL LANGUAGE PROCESSING LAB				
Elective Practical-I	Year III	Semester V	Subject Code 22UDSEP5001	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
CO2	To analyze the understanding of the relationship between NLP and statistics & machine learning.
CO3	To familiarize various NLP software libraries and datasets publicly available.
CO4	To develop systems for various NLP problems namely, spelling correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	3	2
CO2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	2
Average	3	3	2.7	3	3	3	2

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.814

LIST OF EXERCISES
1. How to tokenize a given text?
2. How to get the sentences of a text document ?
3. How to tokenize text with stop words as delimiters?
4. How to remove stop words and punctuations in a text ?
5. How to perform stemming?
6. How to lemmatize a given text ?
7. How to extract usernames from emails ?
8. How to find the most common words in the text excluding stopwords?

9. How to do spell correction in a given text ?
10. How to classify a text as positive/negative sentiment?
11. How to extract Noun and Verb phrases from a text ?
12. How to find the ROOT word of any word in a sentence?
13. Write a Python program to load the iris data from a given csv file into a dataframe and print the shape of the data, type of the data and first 3 rows.
14. Write a Python NLTK program to find the sets of synonyms and antonyms of a given word.
15. Write a Python NLTK program to print the first 15 random combine labeled male and labeled female names from names corpus.

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Books for Study	1.	Jurafsky Dan and Martin James H. "Speech and Language Processing" ,3rd Edition, 2018.
Books for Reference	1.	Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
	2.	Goldberg Yoav "A Primer on Neural Network Models for Natural Language Processing".
	3.	Natural Language Processing with Python, Steven Bird, Ewan Klein, and Edward Loper

Title of the Course/Paper	Elective Practical-I : MOBILE APPLICATION DEVELOPMENT FOR MACHINE LEARNING - LAB				
Elective Practical-I	Year III	Semester V	Subject Code 22UDSEP5001	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To develop components and different Layout for mobile application development framework for android
CO2	To develop Simple GUI application with the Use of Built in components and widgets.
CO3	To create databases to store application data locally
CO4	To Test and Show the results on emulators or on physical handheld devices

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	3	2
CO2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	2
Average	3	3	2.7	3	3	3	2

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.814

LIST OF EXERCISES:

1. Calculator App – Setting up the UI using Linear Layouts
2. Calculator App – Using OnClick and implementing CLR functionality
3. Calculator App – Adding the OnDecimalPoint and OnOperator functionalities
4. Calculator App – Adding Subtraction using split and substring methods
5. Calculator App – Adding other required operators and finalizing the App
6. Quiz App – Setting up the UI using cardview
7. Quiz App – Creating the Question Model and preparing the Questions
8. Quiz App – Setting up the Question UI and Question Activity
9. Quiz App – Selecting right and wrong answers and displaying subsequent Question
10. Quiz App – Preparing UI for the Result Activity
11. TensorFlow Regression App – Editing the Layout File
12. TensorFlow Regression App – Adding TensorFlow Lite Dependencies
13. TensorFlow Regression App – Adding TensorFlow Lite Model
14. TensorFlow Regression App – Writing Activity code for inference

Books for Study	**1.**	Ryan Cohen and Tao Wang, "GUI Design for Android Apps", Apress, 2014.
	2.	John Horton, "Android Programming for Beginners", Second Edition, Packt, 2018.
	3.	Ted Hagos, "Learn Android Studio with Kotlin: Efficient Android App Development", Apress, 2018.
	4.	Laurence Moroney, "AI and ML for Coders", O'Reilly, 2020.

Title of the Course/Paper	Elective Practical-I : REINFORCEMENT LEARNING - LAB				
Elective Practical-I	Year III	Semester V	Subject Code 22UDSEP5001	Credits 3	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To develop the knowledge of basic and advanced reinforcement learning techniques.
CO2	To develop the Identification of suitable learning tasks to which these learning techniques can be applied.
CO3	To analyze the some of the current limitations of reinforcement learning techniques.
CO4	To determine the Formulation of decision problems, set up and run computational experiments, evaluation of results from experiments.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	3	2
CO2	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	2
Average	3	3	2.7	3	3	3	2

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.814

LIST OF EXERCISES:

1. Solving Frozen Lake Problem with Value Iteration

2. Solving Frozen Lake Problem with Policy Iteration

3. Every-visit MC Prediction with Blackjack Game

4. First-visit MC Prediction with Blackjack Game

5. Implementing on-policy MC control

6. Computing Optimal Policy using SARSA

7. Computing Optimal Policy using Q Learning

8. Implementing epsilon-greedy algorithm

9. Implementing Softmax Exploration strategy

10. Implementing Upper Confidence Bound Algorithm

11. Implementing Thomson Sampling strategy

12. Finding the Best Advertisement Banner using Bandits

Books for Study	1.	R. S. Sutton and A. G. Barto. Reinforcement Learning - An Introduction. MIT Press. 2nd Edition. 2018.
	2.	Sudharsan Ravichandran, Deep Reinforcement Learning with Python, PACKT, 2020.
	3.	Video Lectures by Prof. David Silver
	4.	Video Lectures by Prof. B.Ravindran

Title of the Course/Paper	CORE VIII - CLOUD COMPUTING					
Core Theory VIII	Year III	Semester VI	Subject Code 22UDSCT6008	Credits 4	Hours	

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the concepts in Cloud Computing and its Security
CO2	To understand the evolving computer model, cloud computing.
CO3	To introduce the various levels of services that can be achieved by cloud.
CO4	To explain and apply levels of services of Cloud
CO5	To describe the security aspects in the cloud.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	3	2	3	3	3	2
CO2	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	3	2.6	3	3	3	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

UNIT - I

Cloud Computing Foundation: Introduction to Cloud Computing – Move to Cloud Computing – Types of Cloud – Working of Cloud Computing

UNIT - II

Cloud Computing Architecture : Cloud Computing Technology – Cloud Architecture – Cloud Modeling and Design - Virtualization : Foundation – Grid, Cloud and Virtualization – Virtualization and Cloud Computing

UNIT - III

Data Storage and Cloud Computing : Data Storage – Cloud Storage – Cloud Storage from LANs to WANs – Cloud Computing Services : Cloud Services – Cloud Computing at Work

UNIT - IV

Cloud Computing and Security : Risks in Cloud Computing – Data Security in Cloud – Cloud Security Services – Cloud Computing Tools : Tools and Technologies for Cloud – Cloud Mashups – Apache Hadoop – Cloud Tools

UNIT - V

Cloud Applications – Moving Applications to the Cloud – Microsoft Cloud Services – Google Cloud Applications – Amazon Cloud Services – Cloud Applications

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Books for Study	1.	A.Srinivasan and J.Suresh, "*Cloud Computing – A Practical Approach for Learning and Implementation*", Pearson India Publications 2014.
Books for Reference	1.	Rajkumar Buyya, James Broberg, Andrzej , "*Cloud Computing: Principles and Paradigms*", Wiley India Publications 2011.
	2.	Arshdeep Bahga and Vijay Madisetti ,"*Cloud Computing – A Hands on Approach*", Universities Press (India) Pvt Ltd. 2014.
	3.	Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.
	4.	Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.

Web References	1.	NPTEL & MOOC courses titled Cloud computing https://nptel.ac.in/courses/106105167/

Title of the Course/Paper	CORE IX - INTERNET OF THINGS					
Core Theory IX	Year III	Semester VI	Subject Code 22UDSCT6009	Credits 5	Hours	

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the concepts of Internet of Things and the application of IoT.
CO2	To determine the Market Perspective of IoT.
CO3	To Understand the vision of IoT from a global context and use of Devices, Gateways and Data Management in IoT.
CO4	To design IoT applications in different domain and be able to analyze their performance
CO5	To implement basic IoT applications on embedded platforms.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	2	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	2.8	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.942

UNIT – I

IoT & Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT - II
M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT - III
IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - IV
IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and GasIndustry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT - V
Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Books for Study	1.	Vijay Madisetti and ArshdeepBahga, "*Internet of Things: (A Hands-on Approach)*", Universities Press (INDIA) Private Limited 2014, 1st Edition
Books for Reference	1.	Michael Miller, "*The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World*", Pearson Education 2015.
	2.	Francis da Costa, "*Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*", Apress Publications 2013, 1st Edition.
	3.	Waltenegus Dargie, Christian Poellabauer, "*Fundamentals of Wireless Sensor Networks: Theory and Practice*", Wiley 2014.
	4.	CunoPfister, "*Getting Started with the Internet of Things*", O"Reilly Media 2011.

Web References	1.	https://github.com/connectIOT/iottoolkit
	2.	https://www.arduino.cc/

3.	http://www.zettajs.org/

Title of the Course/Paper	CORE X - MACHINE LEARNING				
Core Theory X	Year III	Semester VI	Subject Code 22UDSCT6010	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the To understand basic concepts of machine learning and its applications
CO2	To determine the different machine learning algorithm techniques to evaluate models generated from data.
CO3	To discover how to build machine learning algorithms, prepare data, and use different techniques using Python
CO4	To apply appropriate data sets to the Machine Learning algorithms.
CO5	To implement the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3

CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3
Average	3	2.8	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.971

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UNIT – I: Introduction
Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine Learning – Supervised Learning and Unsupervised Learning – Applications of Machine Learning – Tools Overview for ML.

UNIT – II: Supervised Learning - I
Simple Linear Regression – Multiple Linear Regression – Polynomial Regression – Ridge Regression – Lasso Regression – Evaluating Regression Models – Model Selection – Bagging – Ensemble Methods.

UNIT – III: Supervised Learning - II
Classification – Logistic Regression – Decision Tree Regression and Classification – Random Forest Regression and Classification – Support Vector Machine Regression and Classification - Evaluating Classification Models.

UNIT – IV: Unsupervised Learning
Clustering – K-Means Clustering – Density-Based Clustering – Dimensionality Reduction – Collaborative Filtering.

UNIT – V: Association Rule Learning
Association Rule Learning – Concepts related to ARL – ARL Algorithms - Apriori – Eclat – Concepts and Algorithms.

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Books for Study	1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
Books for Reference	1.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
	2.	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
	3.	Sebastian Raschka, Vahid Mirjilili," Python Machine Learning and deep learning", 2nd edition, kindle book, 2018
	4.	Carol Quadros," Machine Learning with python, scikit-learn and Tensorflow", Packet Publishing, 2018
	5.	Gavin Hackeling," Machine Learning with scikit-learn", Packet publishing, O'Reilly, 2018

Web References	1.	Stanford Lectures of Prof. Andrew Ng on Machine Learning

Title of the Course/Paper	CORE PRACTICAl VI - MACHINE LEARNING LAB				
Core Practical VI	Year III	Semester VI	Subject Code 22UDSCT6010	Credits 4	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To design and evaluate the unsupervised models through python in built functions.
CO2	To evaluate the machine learning model algorithms by python programming.
CO3	To design and apply various reinforcement algorithms to solve real time complex problems.
CO4	To design and develop the code for the recommended system using Natural Language processing.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
Average	3	2.7	3	3	3	3	3

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.957

LIST OF EXERCISES:

1. Write a program to implement the Simple and Multiple Linear Regression
2. Write a program to implement the Polynomial Regression
3. Write a program to implement the Bagging Technique
4. Write a program to implement the Adaboost Methods
5. Write a program to implement Logistic Regression algorithm
6. Write a program to demonstrate the workflow of Decision Tree Classification
7. Write a program to implement the Random Forest Classification
8. Write a program to implement the SVM Classification
9. Write a program to perform the K Means Clustering
10. Write a program to perform the Density based Clustering
11. Write a program to implement the Apriori algorithm for market basket analysis
12. Write a program to compare the Supervised Machine Learning algorithms.

Books for Reference	**1.**	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
	2.	Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Third Edition, 2014.
	3.	Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
	4.	Sebastian Raschka, Vahid Mirjilili," Python Machine Learning and deep learning", 2nd edition, kindle book, 2018
	5.	Carol Quadros," Machine Learning with python, scikit-learn and Tensorflow", Packet Publishing, 2018
	6.	Gavin Hackeling," Machine Learning with scikit-learn", Packet publishing, O'Reilly, 2018
	7.	Stanford Lectures of Prof. Andrew Ng on Machine Learning

Title of the Course/Paper	Elective Theory-II-A INFORMATION SECURITY				
Elective Theory-II -A	Year III	Semester VI	Subject Code 22UDSET6IS2	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To acquire knowledge of cryptography and network security
CO2	To test and evaluate security in systems and networks
CO3	To use methods for planning and designing secure systems
CO4	To apply techniques and tools for secure system deployment and operation
CO5	To Perform continuous testing, assessment and updating of system security

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	2	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3
Average	3	2.8	3	3	3	2.8	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

Unit I

Introduction to Information Security : Attacks, Vulnerability, Security Goals, Security Services and mechanisms - Conventional Cryptographic Techniques : Conventional substitution and transposition ciphers, One-time Pad

Unit II

Block cipher and Stream Cipher, Steganography - Symmetric and Asymmetric Cryptographic Techniques : DES, AES, RSA algorithms

Authentication and Digital Signatures : Use of Cryptography for authentication,

Unit III

Secure Hash function, Key management – Kerberos - Program Security : Nonmalicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors

Unit IV

Salami attack, Man-in-the- middle attacks, Covert channels - Security in Networks : Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong

Unit V

Authentication , Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security – PGP,S/MIME

Books for Study	1.	"Information Systems Today, Managing in the Digital World", Third Edition by Leonard
	2.	M. Jessup; Joseph S. Valacich, Publisher: Prentice Hall
	3.	"Introduction to Information Technology", V. Rajaraman, PHI
Books for Reference	1.	"Information Systems Management in Practice" Barbara C. McNurlin, Ralph H. Sprague, and Publisher: Pearson Education.
	2.	Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
	3.	Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
	4.	Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
	5.	Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

Title of the Course/Paper	Elective Theory-II-B NETWORKSECURITY				
Elective Theory-II -B	Year III	Semester VI	Subject Code 22UDSET6NS2	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To Understand security issues related to networking vulnerabilities, firewalls, intrusion detection systems
CO2	To Identify infrastructure components including devices, topologies, protocols, systems software, management and security
CO3	To Design and develop solutions for technical issues related to networking and security problems.
CO4	To apply footprinting, scanning, enumeration and similar techniques to discover network and system vulnerabilities
CO5	To analyze performance of network security applications, IPSec, Firewall, IDS, Web security, Email security, Malicious software etc.

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs / COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	3	2	3	3	3	2	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3
Average	3	2.8	3	3	3	2.8	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

Unit-I

Introduction: Attack - Services and Mechanism - Model for Internetwork Security - Cryptography - Notion of Plain Text- Encryption Key - Ciphertext - Decryption and Cryptanalysis - Public Key Encryption - Digital Signatures and Authentication

Unit-II

Network Security: Authentication Application - Kerberos - Directory Authentication Service - Pretty Good Privacy

Unit-III

IP Security Architecture: Authentication header - Encapsulating Security Payload combining Security Associations - Key Management

Unit-IV

Web Security: Requirement - Secure Sockets Layer - Transport Layer Security - Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture - SMMPVI1 Communication Facility - SNMPV3

Unit-V

System Security: Intruders - Viruses and Related Threats - Firewall Design Principles - Comprehensive examples using available software platforms/case tools - Configuration Management

Books for Study	1.	William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, Third Edition
	2.	Charlie Kaufman, Radia Perlman and Mike speciner, "Network security, Private communication in a Public World"
	3.	Atul Kahate, "Cryptography and Network Security", TMH, Third Edition.
	4.	V. K. Pachghare "Cryptography and Information Security", PHI
Books for Reference	1.	Christopher M. King, "Security architecture, design deployment and operations", Curtis patton and RSA Press.
	2.	Stephen Northcatt, Leny Zeltser, "INSIDE NETWORK Perimeter Security", Pearson Education Asia
	3.	Robert Bragge, Mark Rhodes, Heith straggberg, "Network Security the Complete Reference", Tata McGraw Hill Publication.

Web References	1.	Stanford Lectures of Prof. Andrew Ng on Machine Learning
	2.	http://www.cert.org/
	3.	http://www.howard.edu/csl/research_crypt.htm
	4.	http://www.cs.purdue.edu/homes/ninghui/courses/426_Fall10/lectures.html
	5.	http://www.cs.uwp.edu/staff/lincke/infosec/

	6.	http://www.cisa.umbc.edu/courses/cmsc/426/fall06/
	7.	http://www.cs.northwestern.edu/~ychen/classes/cs395-w05/lectures.html

Title of the Course/Paper	Elective Theory-II-C BLOCK CHAIN TECHNOLOGY				
Elective Theory-II -C	Year III	Semester VI	Subject Code 22UDSET6BT2	Credits 5	Hours

COURSE OUTCOMES

CO Levels	Course Outcome Statements
CO1	To understand the concepts of block chain technology
CO2	To understand the consensus and hyper ledger fabric in block chain technology.
CO3	To state the basic concepts of block chain
CO4	To paraphrase the list of consensus and Demonstrate and Interpret working of Hyper ledger Fabric
CO5	To implement SDK composer tool and explain the Digital identity for government

Mapping of Course Outcomes to Programme Specific Outcomes

PSOs COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7

CO1	3	2	3	3	3	2	2
CO2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3
Average	3	2.8	3	3	3	2.8	2.8

Strongly Correlated-3 Moderately Correlated-2 Weekly Correlated-1 No Correlation-0

Course Average : 2.914

UNIT - I
History: Digital Money to Distributed Ledgers -Design Primitives: Protocols, Security, Consensus, Permissions, Privacy- : Block chain Architecture and Design-Basic crypto primitives: Hash, Signature-Hash chain to Block chain-Basic consensus mechanisms.

UNIT - II
Requirements for the consensus protocols-Proof of Work (PoW)-Scalability aspects of Block chain consensus protocols**:** Permissioned Block chains-Design goals-Consensus protocols for Permissioned Block chains.

UNIT - III
Decomposing the consensus process-Hyper ledger fabric components-Chain code Design and Implementation: Hyper ledger Fabric II:-Beyond Chain code: fabric SDK and Front End-Hyper ledger composer tool.

UNIT - IV
Block chain in Financial Software and Systems (FSS): -Settlements, -KYC, -Capital markets-Insurance- Block chain in trade/supply chain: Provenance of goods, visibility, trade/supply chain finance, invoice management/discounting.

UNIT - V
Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system / social welfare systems: Block chain Cryptography: Privacy and Security on Block chain.

WEB REFERENCES:
1. NPTEL & MOOC courses titled blockchain technology
2. blockgeeks.comguide/what-is-block-chain-technology
3. https://nptel.ac.in/courses/106105184/

Books for Study	**1.**	Mark Gates, "*Block chain: Ultimate guide to understanding block chain, bit coin, crypto currencies, smart contracts and the future of money*", Wise Fox Publishing and Mark Gates 2017.
	2.	Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "*Hands-On Block chain with*

		Hyper ledger: Building decentralized applications with Hyperledger Fabric and Composer", 2018.
	3.	Bahga, Vijay Madisetti, "*Block chain Applications: A Hands-On Approach*", Arshdeep Bahga, Vijay Madisetti publishers 2017.
Books for Reference	1.	Andreas Antonopoulos, "*Mastering Bitcoin: Unlocking Digital Crypto currencies*", O'Reilly Media, Inc. 2014.
	2.	Melanie Swa, "*Block chain* ",O'Reilly Media 2014.

Web References	1.	Stanford Lectures of Prof. Andrew Ng on Machine Learning
	2.	blockgeeks.comguide/what-is-block-chain-technology
	3.	https://nptel.ac.in/courses/106105184/

Title of the Course/Paper	MINI PROJECT				
PRACTICAL - VIII	**Year III**	**Semester VI**	**Subject Code 22UDSPR6001**	**Credits 5**	**Hours**

OBJECTIVES:

The aim of the mini project is that the student has to understand the real time software development environment. The student should gain a thorough knowledge of the problem he/she has selected and the language / software he/she is using.

Project planning:

B.Sc (Computer Science / Software Application)/BCA Major Project is an involved exercise, which has to be planned well in advance. The topic should be chosen in the beginning of the final year itself. Related reading training and discussions of the first internal project viva voce should be completed in the first term of the final year.

I Selection of the project work

Project work could be of three types.

a) Developing solution for real life problem

In this case a requirement for developing a computer-based solution already exists and the different stages of the system development life cycle is to be implemented successfully. Examples are accounting software for a particular organization, computerization of administrative functions of an organization, web based commerce etc.

b) System Software Project

Projects based on system level implementation. An example is a Tamil language editor with spell checker, compiler design.

b) Research level project

These are projects which involve research and development and may not be as structured and clear cut as in the above case. Examples are Tamil character recognition, neural net based speech recognizer etc. This type of project provides more challenging opportunities to students.

II Selection of team

To meet the stated objectives, it is imperative that a major project is done through a team effort. Though it would be ideal to select the team members at random and this should be strongly recommended, due to practical consideration students may also be given the choice of forming themselves into teams with three members. A team leader shall be selected. Team shall maintain the minutes of meeting of the team members and ensure that tasks have been assigned to every team member in writing. Team meeting minutes shall form a part of the project report. Even if students are doing projects as groups, each one must independently take different modules of the work and must submit the report.

III Selection of Tools

No restrictions shall be placed on the students in the choice of platform/tools/languages to be utilized for their project work, though open source is strongly recommended, wherever possible. No value shall be placed on the use of tools in the evaluation of the project.

IV Project management

The Head of the Department / Principal of the college should publish the list of the student's project topic, internal guide and external organization and teams agreed before the end of July. Changes in this list may be permitted for valid reasons and shall be considered favorably by the Head of the department / Principal of the college any time before commencement of the project. Students should submit a fortnightly report of the progress, which could be an indication of percentage of completion of the project work. The students should ideally keep a daily activity book. Team meetings should be documented and the same should be submitted at the end of the project work.

V Documentation

Three copies of the project report must be submitted by each student (one for the department library, one for the organization where the project is done and one for the student himself/herself). The final outer dimensions of the project report shall be 21cm X 30 cm. The color of the flap cover shall be light blue. Only hard binding should be done. The text of the report should be set in 12 pt, Times New Roman, 1.5 spaced. Headings should be set as follows: CHAPTER HEADINGS 16 pt, Arial, Bold, All caps, Centered.

1. Section Headings 14 pt Bookman old style, Bold, Left adjusted.

1.1 Section Subheading 12 pt, Bookman old style.

Title of figures tables etc are done in 12 points, Times New Roman, Italics, centered.

Content of the Project should be relevant and specific particularly with reference to the work. The report should contain the requirement specification of the work, Analysis, Design, Coding, testing and Implementation strategies done.

• Organizational overview (of the client organization, where applicable)

• Description of the present system

• Limitations of the present system

• The Proposed system - Its advantages and features

• Context diagram of the proposed system

• Top level DFD of the proposed system with at least one additional level of expansion

• Program List (Sample code of major functions used)

• Files or tables (for DBMS projects) list. List of fields or attributes (for DBMS projects) in each file or table.

•   Program – File table that shows the files/tables used by each program and the files are read, written to, updated, queried or reports were produced from them.

• Screen layouts for each data entry screen.

• Report formats for each report.

Some general guidelines on documentation are:

1. Certificate should be in the format**: "Certified that this report titled…   is a bonafide record of the project work done by Sri/ Kum   under our supervision and guidance, towards partial fulfillment of the requirement for award of the Degree of B.Sc Computer Science/B.Sc Computer Science with Artificial Intelligence /B.Sc Computer Science with Data Science /BCA of XXXXXXXX College**" with dated signature of internal guide, external guide and also Head of the Department/ College.

2.   If the project is done in an external organization, another certificate on the letterhead of the organization is required: **"Certified that his/her report titled ……………………………is a bonafide record of the project work done by Sri/Kum…………….under my supervision and guidance, at the ……………..department of………………………**
(Organization) towards partial fulfillment of the requirement for the award of the Degree of B.Sc (Computer Science)/B.Sc Computer Science with Artificial Intelligence /B.Sc Computer Science with Data Science /BCA of XXX College.

3. Page numbers shall be set at right hand bottom, paragraph indent shall be set as 3.

4. Only 1.5 spaces need be left above a section or subsection heading and no space may be left after them.

5.   References shall be IEEE format (see any IEEE magazine for detail) While doing the project keep note of all books you refer, in the correct format and include them in alphabetical order in your reference list.

VI Project Evaluation:

Internal Assessment
There shall be six components that will be considered in assessing a project work with weightage as indicated.
1. Timely completion of assigned tasks as evidenced by team meeting minutes 20%
2. Individual involvement, teamwork and adoption of industry work culture 10%
3. Quality of project documentation (Precision, stylistics etc) 10%
4. Achievement of project deliverables 20%
5 Effective technical presentation of project work 10%
6. Viva 30%
Based on the above 6 components, internal marks (40) can be awarded.

External Assessment
Dissertation/Project submitted at the end of third year shall be valued by two examiners appointed by the Controller for the conduct of practical exams. The board of examiners shall award 40 marks based on the following components.
1. Achievement of project deliverables- 20 Marks
2. Effective technical presentation of project work - 20 Marks
3. Project Viva- 20 Marks
There shall be a common written examination conducted for all the candidates in each group together for a minimum of 10 minutes.
(i) Requirement Specification of Project
(ii) Design of Project
(iii) Testing and Implementation of Project