



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

NATIONAL EDUCATION POLICY - 2020 (NEP-2020)

Basic and Honors Degree Program in

Bachelor of Computer Applications (Science): B.C.A. (Science)

(Faculty of Science & Technology)

Syllabus for S.Y. B.C.A. 3rd and 4th Semesters

To be implemented from Academic Year 2025-2026

Title of the Course: Bachelor of Computer Applications (Science)**Preamble of the syllabus**

The B.C.A. (Science) program is a combination of computer and applied courses from science stream. The computer related courses introduce techniques of programming, databases, web designing, system analysis, design tools and different computing environments. The applied courses include mathematics, statistics and electronics that provide theoretical and practical foundation for the learner.

Objectives

- To produce knowledgeable and skilled human resources that is employable in IT and ITeS.
- To impart knowledge required for planning, designing and building Complex Application Software Systems as well as to provide support for automated systems or applications.
- It helps students analyze the requirements for system development and exposes students to business software and information systems.
- This course provides students with options to specialize in legacy application software, system software or mobile applications.
- To produce entrepreneurs

Introduction

The Structure of three or four Year bachelor's degree programme allows the opportunity to the students to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minor as per their choices and feasibility of exploring learning in different institutions.

This Undergraduate Degree Program has been designed with a semester approach in mind. The First-year courses are aimed at skills development in computers using various technologies while the second year is more focused on core courses providing conceptual frame work. The third year provides the specialization and the project work and fourth year focused on initiate research binge at start-ups level.

Students will be awarded certificate in computer application after one-year completion, diploma in computer application after two years of completion, get B.C.A. degree after three years' completion and B.C.A. (honors) degree after completion of four years. A four-year

degree (Eight - semesters) in Computer Applications will get skills and information not only about Computer and Information Technology but also in communication, organization, research and management with multidisciplinary approach.

Eligibility for Admission:

Any candidate who has passed the XII standard Examination in Science stream from, Maharashtra State Board of Secondary and Higher Secondary Education or equivalent Board of Examination, is eligible for admission to the First Year of this program.

Semester -III S.Y. B.C.A (Science)							
Course Code	Course Type	Course Title	Credits		Evaluation		
			TH	PR	CIA	CSE	Total
24BCA23101	MC	Data Structures	2	-	20	30	50
24BCA23102	MC	Data Structure Laboratory	-	2	20	30	50
24BCA23103	MC	Advanced Database Management System	2	-	20	30	50
	Major IKS	Major IKS	2	-	20	30	50
24BCA23204	Minor	Python Programming Laboratory	-	2	20	30	50
24BCA23205	Minor	Computer Networks	2	-	20	30	50
OR (Choose any one Minor Elective [T])							
24BCA23206	Minor	Statistics for Data Science	2	-	20	30	50
	OE	OE from Commerce Basket	2	-	20	30	50
24BCA23404	VSEC	Advanced Database Management System Laboratory	-	2	20	30	50
24ENG23506	AEC	Hindi/Marathi	2	-	20	30	50
24CC23601	CC	Cultural Activities/ Fine Performing Arts	-	2	20	30	50
24BCA23602	FP	Field Project	-	2	20	30	50
Total			12	10	220	330	550
Total Credits: [12 (TH) + 10 (PR)] = 22							
TH: Theory PR: Practical CIA: Continuous Internal Assessment CSE: College Semester Examination							

Semester -IV S.Y. B.C.A (Science)							
Course Code	Course Type	Course Title	Credits		Evaluation		
			TH	PR	CIA	CSE	Total
24BCA24101	Major	Core Java	2	-	20	30	50
24BCA24102	Major	Core Java Laboratory	-	2	20	30	50
24BCA24103	Major	Data Science	2	-	20	30	50
24BCA24207	Minor	Internet of Things (IoT)	2	-	20	30	50
24BCA24208	Minor	Internet of Things Laboratory	-	2	20	30	50
OR (Choose any one Minor Elective [T + P])							
24BCA24209	Minor	Data Mining	2	-	20	30	50
24BCA24210	Minor	Data Mining Laboratory	-	2	20	30	50
	OE	OE from ARTS Basket	2	-	20	30	50
24BCA24405	VSEC	Software Engineering	2	-	20	30	50
24BCA24407	SEC	Data Science Laboratory	-	2	20	30	50
24ENG24506	AEC	Interview & Professional Skills/ Hindi/ Marathi	2	-	20	30	50
24CC24601	CC	Fitness	-	2	20	30	50
24BCA24603	CEP	Project Based Learning	-	2	20	30	50
Total			12	10	220	330	550
Total Credits: [12 (TH) + 10 (PR)] = 22							
TH: Theory PR: Practical CIA: Continuous Internal Assessment CSE: College Semester Examination							

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA 23101****Subject Name: Data Structure****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand algorithms and analysis of algorithms.
- To learn static and dynamic data structures.

Course Outcomes:

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

- Apply appropriate data structures for the given problem.
- Design an efficient algorithm for the given problem.
- Determine the time and space complexity of a given algorithm

Course Contents

Unit 1: Introduction to Data Structures	4 Hrs
Definition and need of data structures, Types of data structures: Linear and Non-linear, Applications of data structures, Basic operations on data structures: Traversing, Insertion, Deletion, Searching, and Sorting.	
Unit II: Array as a Data Structure	6 Hrs
Representation of arrays (1D, 2D, Multi-dimensional), Operations on arrays: Insertion, Deletion, Traversal, and Searching, Applications of arrays: Searching: Linear Search, Binary Search, Sorting: Bubble Sort, Selection Sort, Insertion Sort, Time and space complexity of sorting and searching algorithms.	
Unit III: Stacks	5 Hrs
Definition, Operations on stacks: push(), pop(), isEmpty(), isFull(), peek(), Implementation of stacks using arrays, Applications: Expression conversion (Infix to Postfix/Prefix), Evaluation of postfix expression, Function call and recursion.	
Unit IV Queue	5 Hrs
Definition and types: Linear Queue, Circular Queue, Priority Queue, Operations on queues: Enqueue, Dequeue, Implementation - Static and Dynamic with comparison, Applications of Queue	

Unit V Linked list	5 Hrs
Introduction to linked lists, Types of linked lists: singly, doubly, circular, Operations on link list: create, traverse, insert, delete, search, Representation: Static & Dynamic, Real world applications of Link list (implementation not expected) ,Comparison between arrays and linked lists.	
Unit VI Trees	5 Hrs
Introduction to trees: Definition and basic terminologies (Root, child, Leaf, Height, etc.), Types of trees: Binary trees, Binary Search Trees, Tree traversals: Inorder, Preorder, Postorder, Real word Applications of trees.	
Reference Books: 1. Classic Data Structures-D. Samanta, Prentice Hall India Pvt. Ltd. 2. Fundamentals of Data Structures in C- Ellis Horowitz, Sartaj Sahni, Susan Anderson Freed, 2nd Edition, Universities Press. 3. Data Structures using C and C++-Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Pearson Education 4. Data Structures: A Pseudo code approach with C, Richard Gilberg ,Behrouz A. Forouzan, Cengage Learning. 5. Introduction to Data Structures in C-Ashok Kamthane, Pearson Education 6. Algorithms and Data Structures, Niklaus Wirth, Pearson Education 7. Data Structures through C, Yashwant Kanetkar	

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA 23102****Subject Name: Data Structure Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Practical: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand algorithms and analysis of algorithms
- To learn static and dynamic data structures

Course Outcomes:

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

- Apply appropriate data structures for the given problem.
- Design an efficient algorithm for the given problem and implement it using C Programming.
- Determine the time and space complexity of a given algorithm

Lab Course Contents

Sr. No	Assignments
1	Basic programs on Data Structures
2	Sorting Techniques: Non-Recursive Sorting Techniques :1. Bubble Sort 2. Insertion Sort Recursive Sorting Techniques : 1.Quick Sort 2.Merge Sort
3	Searching Techniques: 1 Linear search 2.Binary Search
4	Stack and Queue Implementation
5	Linked List Implementation
6	Binary Search Tree

S.Y. B.C.A. SEMESTER III**Subject Code:24BCA23103****Subject Name: Advanced Database Management System****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand advanced SQL features and procedural SQL.
- To study concurrency control and crash recovery techniques.
- To understand the need of database security.
- To learn different database system architecture.

Course Outcomes:

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

- Formulate SQL queries using advanced SQL features.
- Perform Database operations using PL/PostgreSQL.
- Compare and contrast different concurrency control and recovery techniques.
- Apply mechanisms for database security.
- Analyze various database system architectures

Course Contents

Unit-I Relational Database Design	05 Hrs
PL/PostgreSQL: Language structure, Controlling the program flow, conditional statements, loops, Views, Functions and Procedure, Handling errors and exceptions, Cursors, Triggers, Packages	
Unit-II Transaction Concepts	05 Hrs
Transaction, properties of transaction, states of transactions, Concurrent execution of transactions and conflicting operations, Schedules, types of schedules, concept of serializability, precedence graph for serializability	
Unit-III Concurrency Control	05 Hrs
Ensuring serializability by locks, different lock modes, 2PL and its variations, Multiple Granularity locking protocol, Basic timestamp method for concurrency, Thomas Write Rule, Locks with multiple granularity, dynamic database concurrency (Phantom Problem) 6. Timestamps versus locking, Optimistic concurrency control algorithm, multi version concurrency control, Deadlock handling methods - Detection and Recovery (Wait for	

graph), Prevention algorithms (Wound-wait, Wait-die), Deadlock recovery	
Unit-IV Crash Recovery	05 Hrs
Transaction Failure classification, Recovery concepts, Checkpoints, Recovery with concurrent transactions (Rollback, checkpoints, commit), Log base recovery techniques (Deferred and Immediate update), Buffer Management, Shadow paging	
Unit-V Database Security	05 Hrs
Introduction to database security concepts, Methods for database security, Discretionary access control method, Mandatory access control and role based access control for multilevel security, Overview of encryption technique for security, Statistical database security	
Unit-VI Database System Architectures	05 Hrs
Centralized and Client – Server Architectures, Server System Architectures, Introduction to Parallel Systems, Introduction to Distributed Systems, Introduction to Object Based Databases	
Reference Books: 1 Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 6th edition-McGraw-Hill 2 Fundamentals of Database Systems- Ramez Elmasri, Shamkant B. Navathe, 6th edition– Pearson. 3 Database Management Systems -Raghu Ramakrishnan, Johannes Gehrke, 3rd edition, TataMcGraw Hill 4 Introduction to Database Management System- Bipin Desai, 3rd edition, Galgotia Publication 5 An Introduction to Database Systems - C.J. Date, 7th edition, Addison-Wesley 6 Practical PostgreSQL- Joshua D. Drake, John C Worsley, O'Reilly Publications	

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA23205****Subject Name: Computer Networks****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand the basic structure of computer network.
- To understand the important parameters in network layers
- To understand the software and hardware requirements to set up computer network.

Course Outcomes:

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

- Understand the computer networking setup
- Understand the network layer, physical layer and data link layer requirements while setting up network.
- Understand software and hardware requirement of transport and application layer.

Course Contents

Unit I Introduction Computer Networks	04 Hrs
Computer Networks applications –Business Application, Home Application, Broadcast and point-to-point networks, Network Topologies - Bus, Star, Ring ,Network Types- LAN, MAN, WAN, PAN, Wireless Networks, Home Networks, internetworks Protocols and standards – Definition of a Protocol, Protocol standards: De facto and De jure.	
Unit II Network Models	04 Hrs
Concept of Network models, OSI Reference Model: Basic TCP/IP Model – layers and Protocol Suite,Addressing- Physical, Logical, Port addresses, Specific addresses	
Unit III Physical Layer	06 Hrs
Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length, Baseband and Broadband Transmission, Transmission Impairments– Attenuation, Distortion and Noise Data Rate Limits– Noiseless channel: Nyquist’s bit rate, Shannon’s law , Performance of the Network , Line Coding :Concept, Characteristics, Techniques. Transmission Modes: Parallel and Serial Multiplexing:FDM and TDM, Switching-Circuit Switching, Message Switching and Packet Switching.	
Unit IV Data Link Layer	06 Hrs

Functions, Framing – Concept, Types: fixed size, variable size, Framing Methods, Error detection: concept and techniques, Elementary data link protocols (simplex, Stop- And- Wait, Stop and wait ARQ, Go-Back-NARQ Selective Repeat ARQ), Sliding Window Protocols working Principal, ALOHA protocols: working principal, types– pure and slotted,	
Unit V Network Layer	04 Hrs
IPv4 addresses: Address space, Notation, Classful addressing, Classless addressing, Sub netting, Super netting, IPv4: Datagram, Fragmentation, checksum, options, IPv6 addresses: Structure, address space, IPv6:packet format, Extension headers	
Unit VI Transport and Application Layer	06 Hrs
Process-to-Process Delivery, Multiplexing and De-multiplexing, User Datagram Protocol (UDP) - Datagram Format,Checksum, UDP operations, Use of UDP, Transmission Control Protocol (TCP) - TCP Services, TCP Features, TCP Segment Structure, TCP Vs UDP, Domain Name System (DNS) - Distribution of Name Space, DNS in the Internet, E-MAIL - Architecture, User Agent, Message Transfer Agent - SMTP, Web Based Mail, WWW – Architecture , HTTP - HTTP Transaction	
Reference Books: • Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill. • Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13212695-3, Pearson	

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA23206****Subject Name: Statistics for Data Science****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- Students will demonstrate proficiency with statistical analysis of data.
- To aware the student with Measures of Central Tendency & Dispersion.
- To make students capable to identify Correlation and Regression between different statistical data.
- To give the knowledge of Probability Theory.
- To give the knowledge of Logistic Regression with their implementation.
- To aware students with different Hypothesis Testing for statistical analysis of data.

Course Outcomes:

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

- Develop relevant programming abilities.
- Execute statistical analyses with professional statistical software.
- Demonstrate skill in data management.
- Develop the ability to build and assess data-based models

Course Contents

Unit I Basics of Statistics	04 Hrs
Introduction to Statistics, Collection and Scrutiny of Data, Classification and Tabulation of Data, Diagrammatic Presentation of Data, Graphical Presentation of Data.	
Unit II Measures of Central Tendency & Dispersion	04 Hrs
Measures of Central Tendency: Mean, Median and Mode, Measures of Dispersion: - Variance, Standard deviation, Coefficient of variation, Skewness, Kurtosis.	
Unit III Correlation and Linear Regression	06 Hrs
Bivariate data, Scatter diagram, Correlation- Positive Correlation, Negative correlation, Zero Correlation, Karl Pearson's coefficient of correlation(r), Coefficient of determination(r^2) Meaning of regression, Fitting of line $Y=a+bX$ Concept of residual plot and mean residual sum of squares. Multiple correlation coefficient, concept, definition,	

computation and interpretation. Partial correlation coefficient, concept, definition, computation and interpretation. Multiple regression plane, Evaluation of the Model using Rsquare and Adjusted Rsquare.	
Unit IV Introduction to Probability	04 Hrs
Different Approaches to Probability Theory, Laws of Probability	
Unit V Logistic Regression	06 Hrs
Introduction to logistic regression, Difference between linear and logistic regression Logistic equation, Implementation of logistic regression model (R/Python)	
Unit VI Hypothesis Testing	06 Hrs
Central limit theorem- Confidence interval for one mean and difference of two means. Relation between confidence interval and testing of hypothesis, level of significance and p-value. Large sample tests: Single mean, Difference of two means. Small sample tests: t-test for single mean, difference between two means. Chi-square test for single mean, Chi-square test for goodness of fit, Chi-square test for independence of attributes, Introduction to ANOVA.	
Reference Books: • Applied Statistics and Probability for Engineers, Douglas C.Montgomery, George C.Runger, 2018, Wiley(Low price edition available). • Introduction to Mathematics, Statistics Robert V.Hogg. Allen T.Craig, Low price Indian edition by Pearson Education. • Probability and Statistics for Engineers. Richard A.Johnson, Irwin Miller, John Freund. • Mathematical Statistics with Applications. Irwin Miller, Marylees Miller, Pearson Education. • The R Software- Fundamentals of Programming and Statistical Analysis- Pierre Lafayede Micheaux, Rémy Drouilhet, Benoit Lique, Springer2013	

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA23404****Subject Name: Advanced Database Management System Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Practical: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To learn advanced features in SQL such as Nested queries and Views
- To become familiar with PL/PostgreSQL

Course Outcomes:

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

- Formulate SQL queries using advanced features
- Write stored procedures, cursors and triggers using PL/PostgreSQL.
- Design a database using database normalization technique

Lab Course Contents

Sr. No	Assignment
1	Nested query
2	Views
3	Stored functions
4	Errors and Exception handling
5	Cursors
6	Triggers

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA23204****Subject Name: Python Programming Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Practical: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand programming constructs in Python.
- To learn problems solving using Python.

Course Outcomes:

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

- To understand basic concepts in python.
- Design an efficient algorithm for the given problem.
- Using Python, implementing designed algorithm.

Lab Course Contents

Sr. No	Assignment
1	Basics of Python
2	Python List, Tuple and Set
3	Python Dictionary and String
4	Python File and Directories
5	Python Modules and Functions

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24101****Subject Name: Core Java****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To learn Object Oriented Programming language
- To study various java programming concepts like Interface, File and Exception Handling etc.
- To design User Interface using Swing and AWT

Course Outcomes:

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

- Understand the concept of classes, objects, packages and Collections.
- To develop GUI based application

Course Contents**Unit I Introduction to Java****05 Hrs**

Object Oriented Programming concept ,What is Java ,History and evolution ,Features Or Buzzwords of java ,Setup and Environment ,Installing JDK and setting up an IDE , Sample Java program (Hello, World!) , Java Tools – jdbc, javap, Types of Comments,Basics of Java Syntax and Structure, Variables and Data Types ,Operators , Final Variable ,Array, Declaring 1D, 2D Array , Accepting Input (Command Line Arguments, BufferedReader, Scanner)

Unit II Objects and Classes**05 Hrs**

Defining your own classes Access Specifiers (public, protected, private, default), Array of Objects ,Constructors, Overloading Constructors and Use of 'this' keyword static block, static fields And methods, String Class ,String Buffer Class , Formatting String data using format() method , Packages , Wrapper Classes.

Unit III Inheritance and Interface**05 Hrs**

Introduction to inheritance , Need of Inheritance , Syntax and Basics-inheritance , Basics (extends Keyword) and Types of Inheritance, Method Overriding and runtime polymorphism , Abstract class and abstract methods, Defining and Implementing Interfaces Runtime polymorphism using interface,Default and Static Methods,Key Differences

Between Inheritance and Interfaces.	
Unit IV Exception Handling	05 Hrs
Introduction to Exceptions, Types of Exception, Catching Exceptions, Try Catch Block, Creating User Defined Exception.	
Unit V File Handling	05 Hrs
Introduction to Files And Streams , Input- Output Stream : File Input /Output Stream, Buffered Input/ Output Stream, Data Input/Output Stream.	
Unit VI User Interface with Swing	05 Hrs
Swing, The MVC Architecture And Swing, Layouts ,Containers And Components – JButton, JLabel, JText, JTextArea, JCheckBox And JRadioButton, JList, JComboBox, JMenu And related Classes, Dialogs (Message, Confirmation, Input), JFileChooser, JColorChooser.	
Reference Books: 1. Complete reference Java by Herbert Schildt(5th edition) 2. Java 2 programming black books, Steven Horlner 3. Programming with Java , A primer , Fourth edition , By E. Balagurusamy 4. Core Java Volume-I-Fundamentals, Eighth Edition, Cay S. Horstmann, Gary Cornell, PrenticeHall, Sun Microsystems Pres E- References: 1. https://www.sevenmentor.com/wp-content/uploads/2020/06/Core-Java-Automation-Testing-.pdf 2. http://www.faadooengineers.com/threads/32265-Core-Java-Concepts-Pdf-notes-Download	

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24102****Subject Name: Core Java Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Practical: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand collection classes and interfaces.
- To know the process of application development using Graphical User Interface (GUI).
- To acquire knowledge about handling databases using Java.
- To study web components for developing web applications.

Course Outcomes:

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

- Design end to end applications using object oriented constructs.
- Apply collection classes for storing java objects.
- Use Java APIs for program development.
- Handle abnormal termination of a program using exception handling.

Lab Course Contents

Sr. No	Assignment
1	Java Tools and IDE, Classes And Objects
2	Array of Objects Packages
3	Inheritance and Interfaces
4	Exception And File Handling
5	GUI Designing.

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24103****Subject Name: Data Science****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- Provide students with knowledge and skills for data-intensive problem solving and scientific discovery
- Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of large data sets.
- Acquire good understanding of both the theory and application of applied statistics and computer science based existing data science models to analyze huge data sets originating from diversified application areas.
- Be better trained professionals to cater the growing demand for data scientists in industry

Course Outcomes:

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

- Perform Exploratory Data Analysis
- Obtain, clean/process, and transform data
- Detects and diagnoses common data issues, such as missing values, special values, outliers, inconsistencies, and localization.
- Demonstrate proficiency with statistical analysis of data.
- Present results using data visualization techniques.
- Prepare data for use with a variety of statistical methods and models and recognize how the quality of the data and the means of data collection may affect conclusions.

Course Contents

Unit I Introduction to Data Science	05 Hrs
Introduction to data science, The 3 V's: Volume, Velocity, Variety. Why learn Data Science? Applications of Data Science, The Data Science Lifecycle ,Data Scientist's Toolbox, Types of Data : Structured, semi-structured, Unstructured Data, Problems with unstructured data ,Data sources: Open Data, Social Media Data, Multimodal Data, standard datasets .Data Formats(Definitions).	
Unit II Descriptive Statistical Data Analysis	04 Hrs.

Role of statistics in data science, Descriptive statistics: measuring the Frequency, Measuring the Central Tendency: Mean, Median, and Mode. Measuring the Dispersion: Range, Standard deviation, Variance, Interquartile Range. Concept of Outlier, types of outliers, outlier detection methods	
Unit III Inferential Statistical Data Analysis	06 Hrs.
Inferential statistics: Hypothesis testing, Multiple hypothesis testing, Parameter Estimation methods, Measuring Data Similarity and Dissimilarity: Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes, Dissimilarity of Numeric Data: Euclidean, Manhattan, and Minkowski distances, Proximity Measures for Ordinal Attributes.	
Unit IV Data Preprocessing & Cleaning	07 Hrs.
Data Objects and Attribute Types: What Is an Attribute, Nominal, Binary, and Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes Data Quality: Why Preprocess the Data? Data munging/wrangling operations Cleaning Data - Missing Values, Noisy Data (Duplicate Entries, Multiple Entries for a Single Entity, Missing Entries, NULLs, Huge Outliers, Out-of- Date Data, Artificial Entries, Irregular Spacings, Formatting Issues - Irregular between Different Tables/Columns, Extra Whitespace, Irregular Capitalization, Inconsistent Delimiters, Irregular NULL Format, Invalid Characters) Data Transformation – Rescaling, Normalizing, Binarizing, Standardizing, Label Encoding.	
Unit V Data Visualization	06 Hrs.
Introduction to Exploratory Data Analysis, Data visualization and visual encoding, Data visualization libraries, Basic data visualization tools ,Histograms, Barcharts/graphs, Scatter plots, Line charts, Area plots, Pie charts, Donut charts Specialized data visualization tools Boxplots, Bubble plots, Heat map, Dendrogram, Venn diagram, Treemap, 3D scatter plots	
Unit VI Introduction to Data Mining	02 Hrs.
Definition of Data Mining, Data Mining issues, Stages of Data Mining Process, Introduction to Data Mining Techniques, Application Of Data Mining.	
Reference Books: 1) Data Science Fundamentals and Practical Approaches, Gypsy Nandi, Rupam Sharma, BPB Publications, 2020. 2) The Data Science Handbook, Field Cady, John Wiley & Sons, Inc, 2017 3) Data Mining Concepts and Techniques, Third Edition, Jiawei Han, Micheline	

E- Reference:

- 1) https://srdas.github.io/Papers/DSA_Book.pdf
- 2) <https://asolanki.co.in/wp-content/uploads/2019/04/Data-Science-Concepts-and-Practice-2nd-Edition-3.pdf>
- 3) <https://www.cs.cornell.edu/jeh/book.pdf>

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24407****Subject Name: Data Science Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand the basics of R programming
- To study facilities for performing data munging with Python.
- To explore Data analysis and Data Visualization using Python.

Course Outcomes:

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

- Implement data presentation tasks using R.
- Learn python functionalities and features used for data Science.
- Perform data analysis and data visualization using python packages.

Lab Course Contents

Sr. No	Assignment
1	R Programming Basics, Programs using List, Matrix, String and Factors, Program using data frame and visualization
2	The Data Science Environment
3	Statistical Data Analysis: Descriptive and Inferential Statistics
4	Data Preprocessing: Data Munging and Data Wrangling Techniques.
5	Data Visualization: Data visualization libraries, Basic data visualization tools.

S.Y. B.C.A. SEMESTER III**Subject Code: 24BCA24207****Subject Name: Internet of Things(IoT)****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To know methodologies for IoT application development
- To study the IoT protocols, cloud platforms and security issues in IoT \
- To learn real world application scenarios of IoT along with its societal and economic impact

Course Outcomes:

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

- Define Embedded Systems and the Internet of Things
- Apply enabling technologies for developing IoT systems
- Analyze protocols for communication among IoT devices
- Describe cloud-based IoT systems and comprehend security issues in IoT applications

Course Contents

Unit I Introduction to Embedded System	06 Hrs
Introduction to Embedded System Definition, Characteristics of Embedded System, Real time systems, Real time tasks, Processor basics: General Processors in Computer Vs Embedded Processors, Micro controllers and Properties, Components of Microcontrollers, System-On- Chip and its examples, Components of Embedded Systems, Introduction to embedded processor.	
Unit II Internet of Things: Concepts	06 Hrs
Definition, Characteristics of IoT, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Basic Building Blocks. Physical Design of IoT: Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog /Digital Conversion. Logical Design of IoT IoT functional blocks, IoT Enabling technologies, IoT levels and deployment templates, IoT applications	
Unit III IoT Design Methodology- Methods and Interfaces	06 Hrs
Design Steps, Basics of IoT Networking, Networking Components, Internet Structure, IoT	

Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. IP based Protocols: MQTT (Secure), 6LoWPAN, LoRa.	
Unit IV Packages, and Files	08 Hrs
Introduction to Cloud Storage Models, Communication API, Cloud for IoT, Introduction to Amazon Web Services for IoT and SkyNet IoT, Messaging Platform, Introduction to RESTful Web Services -GRPC, SOAP. Security model for IoT, Challenges in designing IOT applications	
Unit V Case Study	04 Hrs
Interfacing of LED/Buzzer/camera/temperature sensor with Arduino/Raspberry Pi.	
Reference Books: • Arshdeep Bahga, Vijay Madiseti, “Internet of Things– A hands- on approach”, Universities Press, ISBN: 0: 0996025510, 13:978-996025515 • Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley Publication, ISBN:978-1-119-99435-0 • Dawoud Shenouda, Peter Dawoud, “Microcontroller and Smart Home Networks”, ISBN: 9788770221566, e-ISBN: 9788770221559 • Charles Crowell, “Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT”, ISBN13 : 979-8613100194 • David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press, ISBN-13: 978-1- 58714- 456-1 ISBN-10: 1-58714-456-5	

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24208****Subject Name: Internet of Things Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To understand basic building blocks of Internet of Things (IoT) and Embedded Systems hardware
- To know methodologies for IoT application development
- To implement the IoT protocols, cloud platforms in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact

Course Outcomes:

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

- Identifying suitable hardware components of Embedded Systems and the Internet of Things
- Develop software as per requirement of IoT application
- Select suitable communication protocols for communication among IoT devices
- Select suitable cloud-based IoT storage and comprehend security issues in IoT applications

Lab Course Contents

Sr. No.	Assignment
1	To Study Raspberry Pi / Arduino Architecture and Basic Programming
2	Interfacing of LED/Buzzer/Push button with Arduino/Raspberry Pi. and write a program to turn ON LED when push button is pressed or at sensor detection and write a program to turn ON LED when push button is pressed or at sensor detection
3	Interfacing Raspberry-Pi/ Adriano with IR sensor/Camera sensor
4	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity reading
5	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth
6	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud

S.Y. B.C.A. SEMESTER IV**Subject Code: 24BCA24209****Subject Name: Data Mining****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To introduce students to the basic concepts and techniques of Data Mining
- To study data mining algorithms for solving practical problems.
- To understand applications and trends in data mining

Course Outcomes:

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

- Identify the key processes of data mining, knowledge discovery
- Design data warehouse with dimensional modeling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems.
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Choose an appropriate method to perform exploratory analysis.
- Interpret results by carrying out data visualization and formal inference procedures

Course Contents**Unit I Introduction to Data Mining****06 Hrs**

Definition Data mining , Data Mining issues , Stages of the Data Mining Process (KDD) , Data Mining Techniques/Tasks , Knowledge Representation Methods , Applications of Data mining.

Unit II Introduction to Data Warehousing**06 Hrs**

Data Pre-processing: Data Cleaning, Data Transformation, Data Reduction Data Discretization, Data Warehousing: Introduction, Architecture and its components, Data Modeling with OLAP: Introduction, Difference between OLTP and OLAP, Schema Design: star Schema

Unit III Data Classification**06 Hrs**

Introduction, Definition, Decision Tree: Introduction , Construction Principle , Attribute Selection Measures , Tree Pruning, Rule-Based Classification: Using IF-THEN Rules for

Classification, Rule Extraction from a Decision Tree, Naïve Bayes Classifier, K-Nearest Neighbor (KNN)	
Unit IV Clustering	06 Hrs
Cluster Analysis: Introduction, Requirements for Cluster Analysis, Hierarchical Method: Agglomerative Hierarchical Clustering, Divisive Hierarchical Clustering, Partitioning Methods: k-Means A Centroid-Based Technique, k-Medoids A Representative Object-Based Technique.	
Unit V Association Rule Mining	05 Hrs
Introduction to Association Rule Mining , Market Basket Analysis, Items, Itemsets and Large Itemsets ,Apriori Algorithm , Kinds of Association Rules , Mining Multilevel association rules, Constraint Based Association rules mining	
Unit 6: Applications and Trends in Data Mining	04 Hrs
Text Mining and Sentiment Analysis, Web Mining: Web Content, Structure, and Usage Mining, Data Mining for Social Media Analytics, Ethical Issues in Data Mining, Future Trends in Data Mining, Introduction to WEKA	
Reference Books: Reference Books: 1)Data Mining: Introductory and Advanced Topics by Margaret Dunham, S. Sridhar, Pearson Publication 2) Data Mining concepts and Techniques by Jiawei Han and Micheline Kamber, ELSEVIER, Third Edition, 3) R and Data Mining, By Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638 4) Data Science from Scratch: First Principles with Python By O'Reilly Media, 20153. 5) Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glenn J. Myatt John Wiley Publishers, 2007	

S.Y. B.C.A. SEMESTER IV**Subject Code:24BCA24210****Subject Name: Data Mining Laboratory****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 04 Hrs./Week****College Semester Examination: 30 Marks****Course Outcomes:**

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

- Apply data preprocessing techniques to clean and prepare data for mining processes.
- Implement classification methods such as Naïve Bayes Classifier to solve real-world problems.
- Perform regression analysis and identify outliers for improved data insights.
- Utilize clustering techniques, including K-Means and hierarchical methods, to group data effectively.
- Generate association rules using the Apriori algorithm to discover relationships among data attributes.
- Explore and operate the WEKA tool for executing various data mining tasks.

Lab Course Contents

Sr. No	Assignments
1	Data Preprocessing
2	Classification Techniques: Naïve Bayes Classifier
3	Regression Analysis and Outlier detection
4	Clustering: K-Means, Hierarchical
5	Association Rules: Perform ARM using Apriori Algorithm
6	Introduction to WEKA (Case Study)

S.Y. B.C.A. SEMESTER V**Subject Code: 24BCA24405****Subject Name: Software Engineering****Credits: 02****Continuous Internal Assessment: 20 Marks****Theory: 02 Hrs./Week****College Semester Examination: 30 Marks****Course Objectives:**

- To learn and understand the principles of System and Software Engineering.
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To learn design processes and software quality parameters

Course Outcomes:

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

- Compare and contrast various Software Engineering models.
- Decide on appropriate process model for a developing a software project.
- Classify software applications and Identify unique features of various domains.
- Prepare System Requirement Specification (SRS) for the given problem.
- Design and analyze Data Flow diagrams

Course Contents

Introduction to System Engineering	02 Hrs
Definition, Basic Components, Elements of the system, System Components, Types of System	
Introduction to Software Engineering	04 Hrs
Definition of Software , Characteristics of Software , Software Application Domain ,Definition of Software Engineering , Need for software Engineering, Mc Call's Quality factors , The Software Process , Software Engineering Practice	
Software Development Life Cycle (SDLC) and Methodologies	04 Hrs
Introduction, Activities of SDLC, A Generic Process Model ,Prescriptive Process models ,Waterfall Model , Incremental Process Models , Evolutionary process Mode	
Requirement Engineering	06 Hrs
Introduction , Requirement Engineering Tasks , Establishing Groundwork for understanding of Software Requirement , Requirement Gathering, Feasibility study ,	

Fact Finding Techniques	
Analysis and Design Engineering	07 Hrs
Decision Tree and Decision Table , Data Flow Diagrams (DFD) , Data Dictionary , Elements of DD ,Advantages of DD , Input and Output Design, PseudoCode, Case Studies on above topics	
Agile Development	07 Hrs
Agility, Agile Process , Principles , The Politics Of Agile Development, Human Factors, Extreme Programming(XP), Adaptive Software Development(ASD), Scrum , Dynamic System Development Model (DSDM), Case Studies on above topics	

Reference Books:

1. Software Engineering: A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010(Seventh Edition)
2. System Analysis, Design and Introduction to Software Engineering (SADSE) - S. Parthsarthy, B.W. Khalkar
3. Analysis and Design of Information Systems(Second Edition) - James A. Senn, McGraw Hill
4. System Analysis and Design- Elias Awad, Galgotia Publication, Second Edition
5. Fundamentals of Software Engineering- Rajib Mall, PHI Publication, Fourth Edition

E-References:

- 1) Software Engineering and Quality Assurance – Mrs Anuradha A. Puntambekar
<https://books.google.co.in/books?id=r203sZeGhhcC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJrl6LpAhU46nMBHeWQCQwQ6AEINDAB#v=onepage&q&f=false>
- 2)Software Engineering – Bharat Bhushan Agarawal and Sumit Prakash Tayal
<https://books.google.co.in/books?id=CDWRq0B9e5kC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJrl6LpAhU46nMBHeWQCQwQ6AEIVzAF#v=onepage&q&f=false>
- 3) Software Engineering – Jibitesh Mishtre and Ashok Mohanty
<https://books.google.co.in/books?id=YnGz2ghKFgC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJrl6LpAhU46nMBHeWQCQwQ6AEIaTAH#v=onepage&q&f=false>