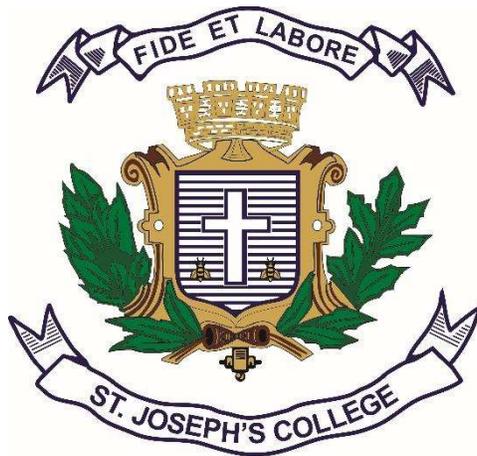


ST JOSEPH'S UNIVERSITY BANGALORE



Re-accredited with 'A++' GRADE with 3.79/4 CGPA by
NAAC Recognized by UGC as College of Excellence

ST. JOSEPH'S INSTITUTE OF INFORMATION TECHNOLOGY DEPARTMENT OF ADVANCED COMPUTING

**SYLLABUS FOR UNDERGRADUATE
PROGRAMME**

**SUMMARY OF CREDITS IN BCA (Data Analytics) -
SEP
Revision Year - 2025**

Department of Advanced Computing (UG)						
<u>Semester 1</u>	Code Number	Title	No. of Hours of Instructions per semester	Number of Hours of teaching per week	Number of credits	Max marks for SE - duration of examination
Theory	BCADA 1124	Fundamentals of computing	45	03	03	60-2Hrs
Theory	BCADA 1224	Exploratory Data Analysis	45	03	03	60-2Hrs
Theory	BCADA 1324	Mathematics I	45	03	03	60-2Hrs
Theory	BCADA 1424	C Programming	45	03	03	60-2Hrs
Theory		Language I	45	03	03	60-2Hrs
Theory		Language II	45	03	03	60-2Hrs
Theory	OE 01	Basics of Data Science	45	03	03	60-2Hrs
Theory	OE 02	Python Programming	45	03	03	60-2Hrs
Practical	BCADA 1P1	C Programming Lab	30	02	01	25- 2 Hrs

Practical	BCADA 1P2	Data Analysis Lab (Excel)	30	02	01	25- 2 Hrs
Total Number of credits:			20			
<u>Semester 2</u>	Code Number	Title	No. of Hours of Instructions	Numbe r of teaching hrs /week	Number of credits	Max marks for SE - duration of examination
Theory	BCADA 2124	Principles and Practices of Data Science	45	03	03	60-2Hrs
Theory	BCADA 2224	Advanced Statistical Computing	45	03	03	60-2Hrs
Theory	BCADA 2324	Mathematics II	45	03	03	60-2Hrs
Theory	BCADA 2424	Python Programming	45	03	03	60-2Hrs
Theory		Language I	45	03	03	60-2Hrs
Theory		Language II	45	03	03	60-2Hrs
Theory	OE 3	Machine Learning using R programming	45	03	03	60-2Hrs
Theory	OE 4	Digital design using HDL	45	03	03	60-2Hrs
Practical	BCADA2 P1	Data Science Lab (Using R)	40	02	01	50- 2 Hrs
Practical	BCADA2 P2	Python Programming Lab	40	02	01	50- 2 Hrs
Total Number of credits:			20			

Department of Advanced Computing (UG)

<u>Semester 3</u>	Code Number	Title	No. of Hours of Instructions per semester	Number of Hours of teaching per week	Number of credits	Max marks for SE - duration of examination
Theory	BCADA 3125	Python for Data Analytics	45	03	03	60-2Hrs
Theory	BCADA 3225	Operating Systems	45	03	03	60-2Hrs
Theory	BCADA 3325	Mathematics - III	45	03	03	60-2Hrs
Theory	BCADA 3425	Econometrics	45	03	03	60-2Hrs
Theory		Language I	45	03	03	60-2Hrs
Theory		Language II	45	03	03	60-2Hrs
Theory	ACOE 01	Entrepreneurship and Innovation	30	02	02	50-2Hrs
Practical	BCADA 3P1	Python for Data Analytics Lab	30	02	01	25- 2 Hrs
Practical	BCADA 3P2	Operating Systems Lab	30	02	01	25- 2 Hrs

Total Number of credits:				22		
<u>Semester 4</u>	Code Number	Title	No. of Hours of Instructions	Number of teaching hrs /week	Number of credits	Max marks for SE - duration of examination
Theory	BCADA 4125	Database Management Systems	45	03	03	60-2Hrs
Theory	BCADA 4225	Multivariate Statistics	45	03	03	60-2Hrs
Theory	BCADA 4325	Data Structures	45	03	03	60-2Hrs
Theory	BCADA 4425	Computer Networks	45	03	03	60-2Hrs
Theory		Language I	45	03	03	60-2Hrs
Theory		Language II	45	03	03	60-2Hrs
Theory	ACOE 2	Data Visualization using POWER BI	30	02	02	50-2Hrs
Practical	BCADA4 P1	Database Management Systems Lab	40	02	01	50- 2 Hrs
Practical	BCADA4 P2	Data Structures Lab	40	02	01	50- 2 Hrs
Total Number of credits:				22		

Course Outcomes and Course Contents

SEMESTER I

Semester	I
Paper Code	BCADA1124
Paper Title	FUNDAMENTALS OF COMPUTING
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

The objective of this course is to provide students with a solid grounding in the fundamental principles of computing and programming. By the end of the course, students will be equipped with the knowledge and skills necessary to solve problems.

COURSE OUTCOMES:

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

CO1: Understand the Fundamentals in Computing

CO2: Understand Core Computing Concepts

CO3: Develop Problem-Solving Skills

CO4: Learn Software Development Principles

CO5: Apply Computing Concepts to Real-World Scenarios

UNIT 1: FUNDAMENTALS OF COMPUTERS

5 Hrs

Introduction to computers - Evolution of computer, Generation of computers, Classification of computer, Applications, Components of computers, Hardware (different types of hardware components), Software (System Software, Application Software, E-accessibility Software), (Open source, freeware and proprietary software), Peripherals (working of keyboard and laser

printer), Computer Network – Basics, Categories, Protocols, Methods of data processing – Single user programming, Multiprogramming, Real-time processing, On-line processing, Time sharing processing, Distributed processing, Computer Security - Types of threats and source of threats.

UNIT 2: BASICS OF COMPUTING AND PROGRAMMING

10 Hrs

Introduction to computing – building blocks for simple programs – problem to program – problem analysis – programming style – documentation and testing – The Problem-Solving aspect – Steps in Problem Solving – Types of Problems – Types of Programming methodologies – Types of Computer Languages – Compiler – Interpreter

UNIT 3: PROBLEM SOLVING TECHNIQUES

10 Hrs

Programming life cycle phases – problem solving – implementation – maintenance – pseudo code representation – Flow charts - algorithms – algorithmic efficiency – complexity of algorithms, Software Development Life Cycle.

Operating System Fundamentals: Operating Systems: Introduction, Functions of an operating System, Classification of Operating Systems, System programs, Application programs, Utilities,

UNIT 4: INTRODUCTION TO DIGITAL ELECTRONICS, NUMBER SYSTEMS, OPERATIONS AND CODES

10 Hrs

Introduction, Decimal numbers, Binary numbers, Number conversion, Binary Arithmetic, 1's and 2's Complements of Binary Numbers, signed numbers, Arithmetic operations with signed numbers, Hexadecimal Numbers, Octal numbers, Binary Coded Decimal(BCD), Digital Codes.

UNIT 5 LOGIC GATES, BOOLEAN ALGEBRA AND LOGIC SIMPLIFICATION

10 Hrs

The Inverter, the AND Gate, the OR gate, the NAND Gate, the NOR Gate, the Exclusive-OR and Exclusive-NOR Gates, Basics of Digital Integrated Circuits. Boolean Operations and Expressions, Laws and Rules of Boolean Algebra, DE Morgans Theorems, Boolean Analysis of Logic Circuits, Simplification Using Boolean Algebra, Standard Forms of Boolean Expressions, Boolean Expressions and Truth Tables, The Karnaugh Map, Karnaugh Map SOP Minimization, POS Minimization.

REFERENCES:

1. M. Morris Mano “Digital Logic and Computer Design”, Pearson, 2013. 2. Thomas L. Floyd, “Digital Fundamentals”, Tenth Edition, Pearson, 2015. 3. Cormen, Leiserson, Rivest, Stein “Introduction to algorithms”, McGraw Hill publishers, 2002.

4. V. Anton Spraul, “Think Like a Programmer – An Introduction to Creative Problem Solving”, no starch press

Semester	I
Paper Code	BCADA1224
Paper Title	EXPLORATORY DATA ANALYSIS
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

- To apply principles of study design and data collection
- Produce and Interpret graphical summaries of data
- Graphically and numerically describe the relation between two or more variables

COURSE OUTCOME:

Upon successful completion of this course student should be able to

- CO1:** Understand the basic concepts of data and its measure
- CO2:** Develop the basic understanding of probability and random variable
- CO3:** Understand the usage of different probability distributions
- CO4:** Evaluate relationship among variables and using the same for prediction
- CO5:** Develop analytical ability to solve real-world problems using these methodologies.

UNIT I: STATISTICS –AN OVERVIEW

9 Hrs.

Need for data, types of data, principles of measurement, sources of data, classification, tabulation and graphical presentation of data, Measures of central tendency: objectives of Averaging, requisites of a measure of Central Tendency, Mathematical Averages: mean, median and mode and quartiles, Measures

of dispersion: significance of Measuring Dispersion, different measures of variation: range, variance, standard deviation, mean deviation, quartile deviation

UNIT II: FUNDAMENTALS OF PROBABILITY

9 Hrs.

Concepts, the parallels between sets and events, Axioms of probability, Probability problems using permutations and combinations, The additive law, the idea of independence, Conditional probability, Bayes Theorem (simple problems. Problems involving conditional probability and dependence), theory of random variables, expectation and variance of random variables, idea of dependent random variables.

UNIT III: PROBABILITY DISTRIBUTIONS

9 Hrs.

Discrete Probability Distributions: Binomial, Poisson, Negative Binomial Distribution, Hypergeometric Distribution, Continuous Probability Distribution: Normal, Exponential Chi square, t and F distributions, Central Limit Theorem, Fitting distributions to data

UNIT IV: CORRELATION ANALYSIS

9 Hrs.

Significance of measuring correlation, types of correlation, methods of correlation analysis, partial and multiple correlation

UNIT V: REGRESSION

9 Hrs.

Some important information about straight lines, the method of least squares, assessing the goodness of fit, assessing each individual predictor - Case Studies related to the above discussed topics using Excel

TEXTBOOKS:

1. Statistics for Managers Using Microsoft Excel, Eighth Edition, David M. Levine, David F. Stephan Kathryn A. Szabat, Pearson Publications

SUGGESTED BOOKS:

1. A First Course in Statistics, Eighth Edition, Ronald Ross. Pearson
2. Probability and Statistics, Second Edition Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan, Schuam Outline Series, Mac Graw Hill
3. Business Statistics, Second Edition, Pearson Education India.

Semester	I
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Paper Code	BCADA1324
Paper Title	MATHEMATICS I
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

Introduce the concepts of set theory, relations and functions, concepts of calculus in one variable and higher dimensions and its applications.

COURSE OUTCOME:

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

CO1: Acquaint the students with mathematical/logical fundamentals including numerical techniques.

CO2: Solve problems involving recurrence relations and generating functions.

CO3: Explain the relationship between the derivative and linear approximation.

CO4: Solving real life maximum and minimum problems.

UNIT I: SET, RELATION AND FUNCTION

12 Hrs.

Sets and Subsets, Set Operations and the Laws of Set Theory, Cartesian Products and Relations, Function: One-to-One, Onto Functions, Function Composition and Inverse Functions, Countable and Uncountable Sets.

UNIT II: DIFFERENTIAL CALCULUS OF ONE VARIABLE

12 Hrs.

Basic properties of Functions: Functions and Their Graphs, Shifting and Scaling Graphs, Limits and Continuity: Limit of a functions and Limit laws, One sided Limit continuity, Limits involving infinity, Asymptotes of Graphs, Derivatives - Tangent Lines and derivative at a Point, The derivative as a function, Differentiation rules, The Chain Rule, Implicit Differentiation, Application of Derivatives: Extreme values of a functions on Closed Intervals, The Mean Value Theorem and related problems.

UNIT III: INTEGRAL CALCULUS**12 Hrs.**

Area and Estimating with Finite Sums, Limits of Finite, The Definite Integral, The Fundamental Theorem of calculus, Area sums, Indefinite Integral and Substitution Method, Area between curves, Arc Length, Area of Surface Revolution, Techniques of Integration , Geometric significance of integration.

UNIT IV: CALCULUS OF SEVERAL VARIABLE**9 Hrs.**

Functions of Several variables, Limit and Continuity in Higher Dimensions, Geometric significance of derivatives, Partial differentiations, The Chain Rule, Directional Derivatives and Gradient Vectors, Extremal Values and Saddle Point, Lagrange's Multipliers.

TEXT BOOKS:

1. "Thomas's Calculus" Pearson, 14th Edition by Joel Hass, Christopher Heil, Maurice D Weir
2. "Introduction to Real Analysis" by S K Mapa, Sarat Book Distributors, 2018,

SUGGESTED BOOKS:

1. Higher Engineering Mathematics by B.S.Grewal
2. "Principle of Real Analysis", 2nd Edition by S.C. Malik, New Academic Science, 2013

Semester	I
Paper Code	BCADA1424
Paper Title	C PROGRAMMING
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

The course is oriented to those who want to learn the fundamental concepts associated with programming basics using C language as an implementation tool. The course will provide students with understanding of programming essentials, including algorithms, data types, elementary control structures and functions used within the framework of imperative and structural programming paradigms.

COURSE OUTCOMES:

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

CO1: Describe the fundamental concepts and syntax of C programming.

CO2: Understand the logic of the program and output obtained using different sets of input.

CO3: Apply logical skills to design and develop algorithms/flow charts to solve real-world problems.

CO4: Gain the knowledge of Functions, Arrays, Structures, Unions and files.

CO5: Design and develop program using appropriate components in C language

UNIT I: BASIC BUILDING BLOCKS OF C PROGRAMMING

5 Hrs

Programming paradigm, Basic structure of C program, compiling and running a C program, Features of C, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Preprocessor directives. Input output operations and Expressions. Formatted input/output functions, Unformatted input/output functions with programming examples using all functions.

Introduction to operator set, Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and Decrement operators, Conditional operators, Bit-wise operators, Special operators. Arithmetic expressions, evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.

UNIT II: DECISION MAKING, BRANCHING, ARRAYS AND STRINGS

10 Hrs

Decision making with 'if' statement, Simple 'if' statement, the 'if...else' statement, nesting of 'if else' statements, The 'else if' ladder, The 'switch' statement, The '?' operator, The 'goto' statement. Looping Statements - The 'for', 'while', 'do-while' statements with examples, jumps in loops - break and continue statements. Arrays and Strings. Introduction to Arrays, Types of arrays, Declaration arrays, Initializing one dimensional and multidimensional array. Introduction, Declaration and Initializing String Variables using arrays, String operations

UNIT III: FUNCTIONS AND RECURSION

10 Hrs

Modular programming, need for functions, types of functions (User Defined and Built –In), working with functions, Definition, declaration and its scope, Category of functions Storage classes, (Automatic, Static, Extern, Register). Recursion – Recursive functions.

UNIT IV: POINTERS

10 Hrs

Introduction, Benefits of using pointers, declaration and Initialization of pointers, obtaining a value of a variable, Pointer arithmetic - parameter passing: Pass by value, Pass by reference, pointer and arrays, dynamic memory allocation with malloc/calloc, Example programs, pointers and arrays, pointers and strings, pointers and functions.

UNIT V: STRUCTURES, UNIONS AND FILES

10 Hrs

Storage class, Structure and union, Features of structures, Declaration and initialization of structures, array of structures, Pointer to structure, Union. file processing, file operations – read, write and seek

REFERENCE BOOKS:

1. Harry H. Chaudhary, “C Programming The ultimate way to learn the fundamentals of the C language”, MIT- Createspace Inc. O-D-Publishing, LLC USA, 2016
2. Yashavant P. Kanetkar, “Let us C”, Fifth edition, BPB Publications, 2006
3. Deitel and Deitel "C How to Program ", Sixth edition, Pearson, 2017

LABORATORY

Semester	I
Paper Code	BCADA1P1
Paper Title	C PROGRAMMING LAB
Number of teaching hrs per week	2 Hrs
Total number of teaching hrs per semester	30
Number of credits	1

1. Implementation of Basic Data types in C.
2. Programs using various operators
3. Implementation of Decision-making statement and Looping statement.
4. Execution of Break, Continue and Switch case statements.

5. Creation of functions in C.
6. Implementing array in C,
7. Sorting and searching elements using array.
8. Creation of Unions and Structures in C.
9. Creation of Pointers in C.
10. Various File Operations in C.

Semester	I
Paper Code	BCADA1P2
Paper Title	DATA ANALYSIS LAB(EXCEL)
Number of teaching hrs per week	2 Hrs
Total number of teaching hrs per semester	30
Number of credits	1

1. Understanding Excel Interface for data Analysis : Getting Stated with Excel , Working with Data
2. Using the fill , series and column commands, Conditional Formatting in Excel
3. Using the visualization tools like charts and graphs in Excel for data comprehension
4. Using the summary statistics in Excel
5. Understanding the variations in data set using Excel commands
6. Creating random numbers in an Excel Spreadsheet
7. Generating probability distributions in Excel
8. Using Excel to understand relationship among Variables
9. Using regression as a prediction tool in Excel
10. Case Study 1
11. Case Study 2

SEMESTER II

Semester	II
Paper Code	BCADA 2124
Paper Title	PRINCIPLES AND PRACTICES OF DATA SCIENCE
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

To make the students learn the process of working with data in large scale. Make the student understand the existence of data with its wilderness and make use of it.

COURSE OUTCOME:

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

- CO1:** Understand the fundamental concepts of data.
- CO2:** Understand the fundamental concepts of data science process.
- CO3:** Understand the fundamental concepts of Machine Learning
- CO4:** Fundamental concepts of large data & Data Visualization
- CO5:** To gain knowledge about the recent trends of Data Science.

UNIT 1: PREPARING AND GATHERING DATA AND KNOWLEDGE

9 Hrs.

Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data- Overview of the data science process- Retrieving data –Data Preparation: Cleansing, integrating, and transforming data - Exploratory data analysis – Data Modeling: Model and variable selection, Model execution, Model diagnostic and model comparison - Presentation and automation: Presenting data, Automating data analysis

UNIT 2: BIG DATA

9 Hrs.

Problems when handling large data – General techniques for handling large data – Case study – Steps in big data – Distributing data storage and processing with Frameworks – Case study.

UNIT 3: MACHINE LEARNING

9 Hrs.

Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.

UNIT 4: DATA VISUALIZATION

9 Hrs.

Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools – Creating an interactive dashboard with dc.js-summary.

UNIT 5 : ETHICS AND RECENT TRENDS

9 Hrs.

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

TEXTBOOKS:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications, 2016.
2. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
3. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.
4. Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O’ Reilly, 1st edition, 2018.

SUGGESTED BOOKS:

1. Doing Data Science, Straight Talk from the Frontline, Cathy O’Neil, Rachel Schutt, O’ Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

Semester	II
Paper Code	BCADA 2224
Paper Title	ADVANCED STATISTICAL COMPUTING
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45

Number of credits	3
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COURSE OBJECTIVE:

- To apply principles of sampling in data collection
- Learn the techniques of estimation
- Apply the regression techniques in solving real life problems

COURSE OUTCOME:

Upon successful completion of this course student should be able to -

CO1: Understand the basic concepts of sampling methods.

CO2: Understand the estimation procedures

CO3: Develop the skill to differentiate between parametric and non-parametric tests

CO4: Understand the use of multiple regression for prediction

CO5: Develop analytical ability to solve real-world problems using these methodologies

UNIT 1: SAMPLING AND SAMPLING DISTRIBUTIONS

9 Hrs.

Principles of Sampling, Sampling methods, Sampling Distributions: mean, difference and proportions

UNIT 2: ESTIMATION AND CONFIDENCE INTERVALS

9 Hrs.

Point Estimation, properties and drawback, Confidence Interval Estimation of population mean and proportions

UNIT 3: HYPOTHESIS TESTING

9 Hrs.

General Procedure, Errors in Hypothesis Testing, testing related to parametric test like Z test, t-test, non-parametric statistics: advantages and limitations, the Chi-Square Distribution, applications of Chi-Square Test Statistic, Mann Whitney U-Test

UNIT 4: MULTIPLE REGRESSION ANALYSIS

9 Hrs.

Assumptions, the basics, testing the accuracy of models, robust regression: bootstrapping, reporting the regression results, regression with categorical data, dummy coding

UNIT 5: ANALYSIS OF VARIANCE

9 Hrs.

One Way and Two-Way Classification, assumptions, logic of F Ratio, post hoc procedures and violations of test assumptions - Case Study related to the above discussed topics using R

TEXTBOOK:

1. Statistical Inference: P. J. Bickel and K. A. Docksum, 2nd Edition, Prentice Hall.
2. Introduction to Linear Regression Analysis: Douglas C. Montgomery

3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013

SUGGESTED BOOK:

1. Computer Age Statistical Inference by Bradley Efron and Trevor Hastie
2. Introduction to Statistical Learning by Gareth James

Semester	II
Paper Code	BCADA 2324
Paper Title	MATHEMATICS II
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVE:

This course will enable students to acquire further skills in the techniques of linear algebra, as well as understanding of the principles underlying the subject. This course will prepare students for further courses in mathematics and/or related disciplines.

COURSE OUTCOME:

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

CO1: Acquaint the students with mathematical/logical fundamentals including numerical techniques

CO2: Understanding the numerical techniques of interpolation in various intervals in real life situations.

CO3: Understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.

CO4: Able to define the various concepts of graphs and its implementations

CO5: Solve the real life problems using finite state machines

UNIT I: MATHEMATICAL LOGIC**10 Hrs.**

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference, Fundamentals of Logic, the Use of Quantifiers, Quantifiers.

UNIT II: FORMAL LANGUAGES AND FINITE-STATE MACHINES**4 Hrs.**

Idea about formal languages, finite state machine.

Case studies

UNIT III: GRAPH THEORY**13 Hrs.**

Introduction to Graphs: Definition of Graph, Loop, Simple Graph, Graph as Models, Path and Cycle, Complete Graph, Bipartite Graph, Digraph, Tree, Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycle, Shortest path algorithms.

Case studies

UNIT IV: INTERPOLATION AND APPROXIMATION**9 Hrs.**

Interpolation with unequal intervals – Lagrange’s interpolation – Newton’s divided difference interpolation – Cubic Splines – Difference operators and relations – Interpolation with equal intervals – Newton’s forward and backward difference formulae.

UNIT V: NUMERICAL DIFFERENTIATION AND INTEGRATION**9 Hrs.**

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson’s 1/3 rule – Romberg’s Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson’s 1/3 rules.

TEXT BOOKS:

1. “Introduction to Graph Theory” PHI Learning Pvt Ltd 2012, Douglas B West
2. “Introductory Method to Numerical Analysis”, Prentice Hall India Learning Private Limited; Fifth edition (1 January 2012), S. S. Sastry.
3. “Introduction to Automata Theory, Languages and Computation “, Pearson Education, 1979, J. Hopcroft, J. Ullman

SUGGESTED BOOKS:

1. Discrete Mathematics with Applications by Thomas Koshy
2. Discrete Mathematics with Applications by Susanna S. Epp

Semester	II
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Paper Code	OE 2
Paper Title	PYTHON PROGRAMMING
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVES:

The course is designed to provide Basic knowledge of Python. Python programming is intended for software engineers, system analysts, program managers and user support personnel who wish to learn the Python programming language.

COURSE OUTCOMES:

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

CO1: To understand the basic concepts in Python programming.

CO2: Learn how to write, debug and execute Python program.

CO3: Understand and demonstrate the use of Branching and Looping Structures.

CO4: To get insight knowledge related to advanced data types such as lists, tuples, dictionaries.

CO5: Acquire the basic knowledge of Object-Oriented Programming Concept and Exception Handling

UNIT I: INTRODUCTION

9 Hrs.

Introduction to Python Programming, History of Python, its features, Scope of Python, Downloading and installing Python, Python code execution process, run a simple program on Python interpreter and IDLE.

UNIT II: DATA TYPES AND OPERATORS

9 Hrs.

The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Illustrative programs.

UNIT III: BRANCHING AND LOOPING

10 Hrs.

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation. Illustrative programs

UNIT IV: LISTS, TUPLES AND DICTIONARIES

10 Hrs.

Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values, Illustrative programs

UNIT V: OOPS AND EXCEPTION HANDLING

7 Hrs.

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, exception handling, Illustrative programs

TEXTBOOKS:

1. Python in easy steps - Mike McGrath, In Easy Steps Limited, Second Edition
2. “Hello World” - Computer Programming for Kids and other Beginners - Warren and Carter, Manning Publications, 2014

SUGGESTED BOOKS:

1. Python3 Tutorial – Tutorialspoint
2. Mark Lutz, Programming Python, O’Reilly, 4th Edition, 2010

LABORATORY

Semester	II
Paper Code	BCADA2P1
Paper Title	DATA SCIENCE LAB (USING R)
Number of teaching hrs per week	2 Hrs
Total number of teaching hrs per semester	30
Number of credits	1

1. Creating and manipulating vector in R
2. Creating matrix and manipulating matrix in R
3. Operations on Data Frames in R

4. Operations on Lists in R.
5. Programs on If – else statements in R
6. Programs on For Loops in R.
7. Customizing and Saving to Graphs in R.
8. PLOT Function in R to customize graphs
9. 3D PLOT in R to customize graphs
10. Implement in R Programming the concept to find Sum, Mean and Product of a Vector, ignore element like NA or NaN.
11. Implement in R Programming the concept to find missing values.
12. Implement the concept to create a list of data frames and access each of those data frames from the list using R.
13. Implement the concept of matrix multiplication and addition using R.
14. Implement linear regression model and compare predicted value with actual value using Visualization.
15. Implement logistic regression model and compare predicted value with actual value using Visualization.
16. Implement k-means clustering.
17. Getting Started with R environment : downloading , installing , using scripts , R workspace, installing packages in R
18. Getting data into R workspace : creating variables, creating data frames , organizing data
19. Manipulating Data : selecting parts of a data frame , data frames and matrices
20. Exploring data with graphs in R
21. Exploring the assumptions of normality in R
22. Understanding Interval Estimation in R
23. Parametric and Non-Parametric Tests in R
24. Testing the Regression models for accuracy
25. Comparing means Using ANOVA

Semester	II
Paper Code	BCADA2P2
Paper Title	PYTHON PROGRAMMING LAB
Number of teaching hrs per week	2 Hrs
Total number of teaching hrs per semester	30
Number of credits	1

SEMESTER III

Semester	I
Paper Code	BCADA3125
Paper Title	Python for Data Analytics
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

PYTHON FOR DATA ANALYTICS

45 Hrs

LEARNING OUTCOME

The objective of this course is to equip students with a fundamental understanding of Big Data, including its characteristics, storage, and processing frameworks. Students will develop proficiency in using NumPy and Pandas for numerical computing and data manipulation, perform data wrangling techniques such as merging, reshaping, and transforming datasets, and apply data aggregation, grouping, and transformation operations. Additionally, students will learn to utilize visualization libraries like Matplotlib and Seaborn to create meaningful data representations for effective data analysis and decision-making.

COURSE OUTCOMES

CO 1: Understand the fundamentals of Big Data, its characteristics, storage mechanisms, and processing frameworks.

CO 2: Develop proficiency in using NumPy and Pandas for numerical computing and data manipulation.

CO 3: Perform data wrangling techniques, including merging, reshaping, transforming, and cleaning data.

CO 4: Apply data aggregation, grouping operations, and transformation techniques using Pandas.

CO 5: Utilize visualization libraries such as Matplotlib and Seaborn to create meaningful data visualizations.

UNIT I - INTRODUCTION TO BIG DATA

9 Hrs

Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics - Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Applications – Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – MapReduce and YARN – Map Reduce Programming Model

UNIT II - NUMPY AND PANDAS PACKAGES

9 Hrs

NumPy ndarray - Vectorization Operation - Array Indexing and Slicing - Transposing Array and Swapping Axes - Saving and Loading Array - Universal Functions - Mathematical and Statistical Functions in NumPy .

Series and DataFrame data structures in pandas - Creation of Data Frames – Accessing the columns in a DataFrame - Accessing the rows in a DataFrame - Panda's Index Objects - Reindexing Series and DataFrames - Dropping entries from Series and Data Frames - Indexing, Selection and Filtering in Series and Data Frames - Arithmetic Operations between Data Frames and Series - Function Application and Mapping.

UNIT III - DATA WRANGLING

9 Hrs

Combining and Merging Data Sets – Reshaping and Pivoting – Data Transformation – String manipulations – Regular Expressions.

UNIT IV - DATA AGGREGATION AND GROUP OPERATIONS

9 Hrs

Group By Mechanics – Data Aggregation – GroupWise Operations – Transformations – Pivot Tables – Cross Tabulations – Date and Time data types.

UNIT V - VISUALIZATION IN PYTHON

9 Hrs

Matplotlib and Seaborn Packages – Plotting Graph - Controlling Graphs – Adding Text – More Graph Types – Getting and Setting Values – Patches.

REFERENCES:

- 1.Gowrishanker and Veena, “Introduction to Python Programming”, CRC Press, 2019.
- 2.Python Crash Course, 2nd Edition, By Eric Matthes, May 2019
- 3.NumPy Essentials, By Leo Chin and Tanmay Dutta, April 2016
- 4.Joel Grus, “Data Science from scratch”, O'Reilly, 2015.
- 5.Wes Mc Kinney, “Python for Data Analysis”, O'Reilly Media, 2012.
- 6.Kenneth A. Lambert, (2011), “The Fundamentals of Python: First Programs”, Cengage Learning
- 7.Jake Vanderplas. Python Data Science Handbook: Essential Tools for Working with Data 1st Edition.

Semester	III
Paper Code	BCADA 3225
Paper Title	OPERATING SYSTEM
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVES:

1. To analyze the various evolutions of operating systems.
2. To learn the basic concepts and roles of an operating system.
3. To study the various design issues in developing an operating system.
4. To familiarize with the important mechanisms in operating systems.
5. To appreciate the emerging trends in operating systems.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- CO1:** Understand the evolution of Operating systems
- CO2:** Understand the Key concept of Operating Systems
- CO3:** Analyze the issues in designing Operating Systems
- CO4:** Analyze the usage and strengths of various algorithms of Operating Systems
- CO5:** Appreciate the role of various concepts and algorithms towards the performance of the system

UNIT I: OPERATING SYSTEMS OVERVIEW

10 Hrs.

Introduction to operating systems – Computer system organization, architecture – Operating system structure, operations–Process, memory, storage management–Protection and security–Distributed systems – Computing Environments – Open-source operating systems – OS services – User operating-system interface – System calls – Types – System programs – OS structure – OS generation – System Boot – Process concept, scheduling – Operations on processes – Cooperating processes – Inter-process communication

UNIT II: PROCESS MANAGEMENT**10 Hrs.**

Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple-processor scheduling, Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.

UNIT III: STORAGE MANAGEMENT**8 Hrs.**

Memory Management – Swapping – Contiguous memory allocation – Paging –Segmentation – Demand paging - Page replacement – Allocation of frames – Thrashing.

UNIT IV: I/O SYSTEMS**9 Hrs.**

File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling – Disk management – Swap-space management – Protection.

UNIT V: CASE STUDY**8 Hrs.**

The Linux System – History – Design Principles – Kernel Modules – Process Management – Scheduling – Memory management – File systems – Input and Output – Inter-process Communication

TEXT BOOK:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 2010.

REFERENCES:

1. Andrew S.Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley,2001.
2. D M Dhamdhere, "Operating Systems: A Concept-based Approach", Second Edition, Tata McGraw-Hill Education,2007.
3. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education,1996.
4. William Stallings, "Operating Systems: Internals and Design Principles", Seventh Edition, Prentice Hall,2011.

Semester	III
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Paper Code	BCADA 3325
Paper Title	MathematicsIII
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVES:

- To understand the basic concepts and techniques of solving algebraic equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

COURSE OUTCOMES:

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

CO1: Understanding the basic concepts and techniques of solving algebraic equation and matrices techniques for solving systems of linear equations in the different areas of Linear Algebra.

CO2: Understanding the numerical techniques of interpolation in various intervals in real life situations.

CO3: Understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.

CO4: Knowledge of various techniques and methods of solving ordinary differential equations

CO5: Understanding database the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I: MATRICES

12 Hrs.

System of linear equation, Row reduction and echelon forms, vector equation, Matrix equation, Solution sets of linear systems, Linear Independence, Introduction to Linear Transformation, The matrix of a Linear Transformation. Matrix Operations, The Inverse of a matrix, Characterization of Invertible Matrices, Subspaces of R^n and Dimension and rank.

UNIT II: SOLUTION OF EQUATIONS AND EIGENVALUE PROBLE

9 Hrs.

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton-Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT III: VECTOR SPACES

12 Hrs.

Vector spaces, subspaces, Null spaces, Column Spaces and Linear Transformation, linearly independent set and Bases, Coordinate system, The dimension of a vector space, Rank, Change of Basis, Eigenvectors and Eigenvalues, The characteristic equation, Diagonalization.

UNIT IV: DIFFERENTIAL EQUATIONS

9 Hrs.

Introduction to differential equations, Formation of differential equations, Equations of First Order and First Degree: Solving equations of second and higher order homogeneous equations with constant coefficients, solving equations of second and higher order non-homogeneous equations with constant coefficients by finding the complementary function particular integral.

SELF-STUDY

3 Hrs.

TEXT BOOKS:

1. "An introduction to Differential Equation", New Central Book Agency, 2011, R K Ghosh and K C Maity.
2. "Introductory Method to Numerical Analysis", Prentice Hall India Learning Private Limited; Fifth edition (1 January 2012), S. S. Sastry
3. "Linear Algebra and its Applications," 3rd edition, Pearson Education (Asia) Pte. Ltd, 2005. David C. Lay

SUGGESTED BOOKS:

1. "Linear Algebra with Applications, 8th Edition By Steve Leon

2. "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd/2004. Kenneth Hoffman and Ray Kunze

Semester	III
Paper Code	BCADA 3425
Paper Title	ECONOMETRICS
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVES:

To equip the students with the knowledge of the techniques of modern econometrics, required for applied research in data analytic industry.

COURSE OUTCOMES:

Upon successful completion of this course student should be able to

CO1: To get familiar with the concept of econometrics

CO2: To get insights into classical linear regression

CO3: To familiarize the concept of relaxation of assumptions of classical regression model

CO4: To get insights of Non-linear relationship

CO5: To solve the Simultaneous equations using different methods

UNIT I : INTRODUCTION TO ECONOMETRICS

8 Hrs.

Nature and Scope of Econometrics - Meaning of Econometrics, Relationship Between Statistics, Mathematics and Economics, Economic and Econometric Models, the aims and methodology of Econometrics, statistical Vs deterministic relationship, regression Vs Causation, regression Vs correlation, terminology and notation, the nature and sources of data for Econometric analysis. Review of basic statistical concepts, Population and Sample, Random variables, Probability distribution function, Multivariate probability density functions, Expected value, Variance, Co variance, Correlation Co efficient.

UNIT II: CLASSICAL LINEAR REGRESSION

8 Hrs.

Two Variable Regression Analyses - the basic two Variable Regression model: OLS Estimation, Hypothesis testing, Extensions of two variable regression model – Functional forms of regression model. Interpretation of multiple regression coefficients , properties of regression coefficients, multicollinearity, goodness of fit.

UNIT III: RELAXING THE ASSUMPTIONS OF THE CLASSICAL REGRESSION MODEL **10 Hrs.**

Multi-collinearity, Heteroscedasticity and Autocorrelation- Nature, Consequences, Detection and Remedial Measures

UNIT IV: UNDERSTANDING NON-LINEAR RELATIONSHIPS **6 Hrs.**

Transformation of variables - Logarithmic transformations, Engel curve, semi- logarithmic transformation, non linear regression, use of dummy variables in regression

UNIT V: SIMULTANEOUS EQUATIONS SYSTEM **8 Hrs.**

Identification problem, Least Squares estimation , Bias Problem

SUGGESTED BOOKS:

1. Cristopher Dougherty Introduction to Econometrics
2. Johnson , Econometric Methods
3. Damodar Gujrati , Econometrics
4. The Econometrics of Financial Markets : J. Campbell, A.Lo and C. Mackinlay
Econometric Analysis : William H. G

ACOE 1: ENTREPRENEURSHIP AND INNOVATION

Total No. of Lectures: 30	Total Marks : 50	[L – T – P – S]
No. of Lectures / Week: 2	Credits : 2	[2 – 1 – 0 – 1]

Course objectives:

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

- Understand entrepreneurial skillset and mindset
- Identify problems as catalyst for innovation
- Develop customer personas based on initial research

- Enhance customer personas based on market/other feedback
- Examine the core principles of lean startups/design thinking
- Acquire techniques for narrowing down solutions to the most viable options (map problem-JTBD-solution idea)
- Understand contemporary competition and market influences
- Understand solution: prototyping vs. MVPs

Course Outcomes:

After successful completion of this course, the students should:

- Commit to higher career possibilities enabled by entrepreneurial skills
- Scope a problem worth solving with user impact, and personal drivers
- Enhance customer personas based on market/other feedback
- Analyze responses to uncover insights on customer needs/JTBD/problems
- Pivot problem/customer segmentation based on customer insight
- Acquire techniques for narrowing down solutions to the most viable options (map problem-JTBD-solution idea)
- Apply learn method to estimate the Total Addressable Market (TAM)
- Develop & exhibit fundamental skills to prototype
- Apply market analysis in planning
- Craft an initial sales plans

UNIT I

Orientation: Entrepreneurial leadership and its relevance of entrepreneurial mindset for students' career choices-Overview of global/Indian startup ecosystems-Introduction to design thinking/innovation.

Problem Identification: Develop macro industry-problem perspective - Assemble 'real-world' problems - Analyze problems. **(05 Hours)**

UNIT II

Customer Identification: Identify customer segments. Assess 'Jobs-To-Be-Done' (JTBD) for a customer segment-Develop customer personal. **Customer Needs Validation:** Understand customer validation-Validate customer-problem fit-Pivot/refine customer-problem fit for feasibility. **Solution Idea Generation:** Examine ideation techniques-Generate solution ideas. **Opportunity and Competition**

Mapping: Identify global competitors-Review industry trends-Estimate market size (TAM).
(07 Hours)

UNIT III

Prototype Development and MVP: Overview of prototypes & MVP - Build an initial prototype-Prototypes for early validation. **Opportunity (feasibility) assessment:** Map your relative position in the market-Estimate opportunity size. **Business Modelling:** Examine revenue models-Review and organize the lean canvas-Build the lean canvas for your startup. **(06 Hours)**

UNIT IV

Marketing and Sales Strategy: Understand marketing and sales-Recommend a GTM approach-Map a sales process. **Financial management for profitability:** Understand startup costs-Get started with financial planning-Analyse the path to profitability-Understand bootstrapping strategies & explore funding options. **Team and talent requirements:** Finding co-founders and mentors-Building an initial team. **(07 Hours)**

UNIT V

Venture Idea Pitch Readiness: Scale orientation - Persuasive story-telling for a feasible venture idea. Final Milestone - Venture Idea Feasibility Presentation - **Milestone 3:** Venture idea feasibility (external jury presentation) **(05 Hours)**

Text Books

- [1] Dr. R. Paulmoni, "Entrepreneurship, Innovation And Creativity", AG Publishing House, First Edition, 2024.
- [2] H. James Harrington, "Creativity, Innovation, and Entrepreneurship", Productivity Press; 1st edition (11 December 2018).

Reference Books:

- [1] Peter F. Drucker, Innovation and Entrepreneurship, Harper Business; Reprint edition (9 May 2006)
- [2] Michael Michalko, "Creative Thinking", New World Library; Original edition (6 September 2011)

SEMESTER IV

Semester	IV
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Paper Code	BCADA 4125
Paper Title	DATABASE MANAGEMENT SYSTEM
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE DESCRIPTION:

To provide strong foundation for databases, tables, database management system and application area related to it and understand the underlying core concepts.

COURSE OBJECTIVES:

This course concentrates on introduction, principles, design and implementation of DBMS. It introduces about the distributed system and brief about data mining and data warehouse. To provide strong foundation of database concepts and develop skills for the design and implementation of a database application with a brief exposure to advanced database concepts.

COURSE OUTCOMES:

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

CO1: Understanding the fundamental concepts of Database Management systems

CO2: Understanding the concepts of Database models.

CO3: Understanding the core terms, concepts, and tools of relational database management systems.

CO4: Understanding database design and logic development for database programming.

UNIT I: DATABASE MANAGEMENT SYSTEM INTRODUCTION

10 Hrs.

Data- Database- Database management system- Characteristics of the database approach- Role of Database administrators- Role of Database Designers- End Users- Advantages of Using a DBMS-Data models, Schema and Instances –Database design - Database Engine – 1 tier architecture – 2 tier architecture- 3 tier architecture – History of Database Management systems- Types of Databases.

UNIT II: DATABASE MODELS AND IMPLEMENTATION

10 Hrs.

Data Model and Types of Data Model- Relational Data Model- Hierarchical Model- Network Data Model- Object/Relational Model- Object-Oriented Model- Entity-Relationship Model- Modeling using E-R Diagrams- Notation used in E-R Model- Relationships and Relationship Types- Cardinalities. Subclasses, Super classes and Inheritance – Specialization and Generalization – Characteristics of Specialization and Generalization – Modeling of UNION types with categories- An example University EER Schema.

UNIT II: RELATIONAL DATABASES

10 Hrs.

Structure of relational databases- Properties of relational databases and Tables –Structure of relational databases – Database Schema – Armstrong Axioms – Functional Dependency-Anomalies in a Database- Properties of Normalized Relations- First Normalization- Second Normal Form Relation- Third Normal Form- Boyce-Codd Normal Form (BCNF).

UNIT IV: SQL AND ADDITIONAL CONCEPTS

10 Hrs.

Categories of SQL Commands; Data Definition; Data Manipulation Statements, SELECT - The Basic Form, Subqueries, Functions, GROUP BY Feature, Updating the Database, Data Definition Facilities. MongoDB Overview- MongoDB Data modeling.

SELF STUDY

5 Hrs.

REFERENCE BOOKS:

1. Elmasri Ramez and Navathe Shamkant B, Fundamentals of Database Systems, Addison-Wesley, 6th Edition, 2010.
2. Silberschatz, Korth, Sudarshan, Database System Concepts, 5 Edition, McGraw Hill, 2006.
3. O’neil Patricand, O’neil Elizabeth, Database Principles, Programming and Performance, 2nd Edition, Margon Kaufmann Publishers Inc, 2008.

Semester	IV
Paper Code	BCADA 4225
Paper Title	MULTIVARIATE STATISTICS
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45

Number of credits	3

COURSE OBJECTIVE: The aim of this course is to appraise the students about the concepts and methods of multivariate analysis

COURSE OUTCOMES:

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

- CO1:** To get an insight into the application of multivariate analysis
- CO2:** To familiarize the students with the concept of multivariate normal distribution
- CO3:** To familiarize the students with multiple regression
- CO4:** To get insights into the concepts of data reduction using principal component analysis
- CO5:** To get insights into factor analysis

UNIT I: ASPECTS OF MULTIVARIATE ANALYSIS 5 Hrs.

Application of Multivariate Techniques, the organization of data , data displays and pictorial representations , matrix algebra and random vectors

UNIT II: THE MULTIVARIATE NORMAL DISTRIBUTION 10 Hrs.

The Multivariate Normal Density and its properties, mean vector , Covariance Matrix , Correlation Matrix , Relationship between Correlation and covariance matrix , Multivariate Normal Distribution – Geometric interpretation , Examining data for multivariate Normal Distribution , Multivariate Inferential Statistics : Hotelling’s T^2 , Confidence Region , Hypothesis Testing for Equality of two population mean Vectors

UNIT III: MULTIPLE LINEAR REGRESSION 10 Hrs.

Assumptions and Estimation of Model Parameters , Sampling distribution of parameter estimates , Model Adequacy Test, Tests of assumptions , Remedy against violations of assumptions, multivariate Linear Regression ,

UNIT IV: PRINCIPAL COMPONENT ANALYSIS 10 Hrs.

Conceptual Model , Extraction of Principal Components , Model Adequacy and Interpretation

UNIT V: FACTOR ANALYSIS 10 Hrs.

Factor Analysis : Basic and Orthogonal Models , Types of Models , parameter estimation , Model Adequacy Tests and Factor Rotation

SUGGESTED BOOKS:

1. Applied Multivariate Statistical Analysis by R A Johnson and D W Wichern, Sixth Edition, PHI, 2012.
2. Multivariate data analysis by Joseph F. Hair Jr, Rolph E. Anderson, Ronald L Tatham, and William C. Black, Fifth Edition, Pearson Education, 1998.
3. Analysing multivariate data by J Lattin, J D Carroll and P E Green, Cengage Learning, 2010.
4. Applied multivariate analysis by N H Timm, Springer, 2002.
5. An Introduction to multivariate Statistical Analysis , T.W Anderson , Third Edition , Wiley Student Edition

Semester	IV
Paper Code	BCADA 4325
Paper Title	DATA STRUCTURES USING PYTHON
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

DATA STRUCTURES USING PYTHON**TOTAL HOURS 45****COURSE OBJECTIVE**

To equip students with a comprehensive understanding of Object-Oriented Programming (OOP) concepts, Python-specific data structures, and fundamental algorithms, enabling them to design, implement, and analyze efficient solutions using linear and non-linear data structures for real-world computational problems.

LEARNING OUTCOME

Upon completion of the course, students will be able to design and implement efficient programs using OOP principles, utilize Python data structures and algorithms effectively, and apply linear and non-linear data structures to solve complex computational problems, demonstrating proficiency in problem-solving and software development.

CO 1: Understand and apply Object-Oriented Programming (OOP) concepts to design and implement efficient and reusable code.

CO 2: Demonstrate proficiency in Python-specific data structures to manipulate and process data effectively.

CO 3: Analyze and implement fundamental array operations, and apply various algorithms to solve computational problems.

CO 4: Implement and evaluate linear data structures and apply them to real-world problems.

CO 5: Explore and implement non-linear data structures to solve complex problems.

UNIT – I

9 Hrs

Oops Concepts- class, object, constructors, types of variables, types of methods. Inheritance: single, multiple, multi-level, hierarchical, hybrid; Polymorphism: with functions and objects, with class methods, with inheritance. Abstraction: abstract classes.

UNIT – II

7 Hrs

Data Structures – Definition, Linear Data Structures, Non-Linear Data Structures Python Specific Data Structures: List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, and slicing.

UNIT - III

9 Hrs

Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs List. Searching -Linear Search and Binary Search. Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.

UNIT - IV

9 Hrs

Linked Lists – Implementation of Singly Linked Lists, Doubly Linked Lists, Circular Linked Lists. Stacks - Overview of Stack, Implementation of Stack (List & Linked list), Applications of Stack Queues: Overview of Queue, Implementation of Queue(List & Linked list), Applications of Queues, Priority Queues.

UNIT - V

11 Hrs

Graphs -Introduction, Directed vs Undirected Graphs, Weighted vs Unweighted Graphs, Representations, Breadth First Search, Depth First Search. Trees - Overview of Trees, Tree Terminology, Binary Trees: Introduction, Implementation, Applications. Tree Traversals, Binary Search Trees: Introduction, Implementation, AVL Trees: Introduction, Rotations, Implementation.

TEXTBOOKS:

1. Data structures and algorithms in Python by Michael T. Goodrich

2. Data Structures and Algorithmic Thinking with Python by Narasimha Karumanchi

REFERENCE BOOKS:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka. 2. Data Structures and Algorithms with Python by Kent D. Lee and Steve Hubbard.

3. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum.

4. Core Python Programming -Second Edition, R. Nageswara Rao, Dreamtech Press

Semester	V
Paper Code	BCADA5425
Paper Title	COMPUTER NETWORKS
Number of teaching hrs per week	3 Hrs
Total number of teaching hrs per semester	45
Number of credits	3

COURSE OBJECTIVES:

- To understand the protocol layering and physical level communication
- To analyse the performance of a network
- To understand the various components required to build different networks
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport, Network and application layer

COURSE OUTCOMES:

On successful completion of this course, the student will able to

CO1: Comprehend the basic layers and its functions in computer networks.

CO2: Understand the basics of how data flows from one node to another.

- CO3:** Analyse and design routing algorithms.
CO4: Design protocols for various functions in the network.
CO5: Understand the working of various application layer protocols.

UNIT I: INTRODUCTION AND PHYSICAL LAYER **9 Hrs.**

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT II: DATA-LINK LAYER & MEDIA ACCESS **9 Hrs.**

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III: NETWORK LAYER **9 Hrs**

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV: TRANSPORT LAYER **9 Hrs.**

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V: APPLICATION LAYER **9 Hrs.**

WWW and HTTP – FTP – Email – Telnet – SSH – DNS – SNMP.

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

REFERENCE BOOKS

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Seventh Edition, Pearson Education, 2017.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.

4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.

Semester	IV
Paper Code	OE 4
Paper Title	Data Visualization using POWER BI
Number of teaching hrs per week	2 Hrs
Total number of teaching hrs per semester	30
Number of credits	2

COURSE OBJECTIVE:

- Understand the basic concepts of data analysis, data visualization, and data modeling
- Navigate the Power BI Desktop interface.
- Import data from various sources into Power BI
- Create basic data models and relationships between tables.
- Use DAX (Data Analysis Expressions) to create calculated columns and measures.
- Create interactive reports and visualizations using various chart types, tables, and other visualization tools.
- Design and publish dashboards for stakeholders.
- Use Power BI service to share dashboards and reports with others.
- Understand the security and governance considerations in using Power BI.

COURSE OUTCOME:

On successful completion of this course, the student will be able to

CO1: Understanding of basic concepts of Power BI

CO2: Creating and applying data models in Power BI

CO3: Visualising datasets using Power BI

CO4: Understanding and applying data modelling and visualisation techniques using the advanced features of Power BI

CO5: Creating Dashboard using Power BI

CO6: Learning security, Collaboration and best practices of Power BI

UNIT I: INTRODUCTION TO POWER BI **7Hrs**

- Introduction to Power BI and its features
- Power BI Desktop and Power BI Service
- Data sources and connectors

UNIT II: DATA MODELING IN POWER BI **7 Hrs**

- Creating data models and relationships
- Introduction to DAX (Data Analysis Expressions)

UNIT III: DATA VISUALIZATION IN POWER BI **7 Hrs**

- Introduction to data visualization
- Creating charts, tables, and other visualization tools
- Using filters and slicers

UNIT IV: ADVANCED DATA MODELING AND VISUALIZATION **8 Hrs**

- Advanced data modeling techniques
- Advanced visualization techniques
- Custom visuals and importing from AppSource.

UNIT V: CREATING DASHBOARDS **8 Hrs**

- Introduction to dashboards
- Designing and creating dashboards in Power BI
- Sharing and collaborating on dashboards

UNIT VI: SECURITY AND GOVERNANCE IN POWER BI **8 Hrs**

- Security considerations in Power BI
- Sharing and collaboration in Power BI
- Best practices for governance and administration

SUGGESTED BOOKS:

1. Mastering Microsoft Power BI By *Brett Powell*
2. Beginning Power BI by Dan Clark

