SYLLABUS PROPOSED FOR
B.Sc. DATA SCIENCE AND ANALYTICS
(Three Year Degree Course)

PROGRAMME EDUCATIONAL OBJECTIVES (PEO's):

The Program Educational Objectives (PEOs) of the Computer Applications are listed below:

PEO1. To prepare graduates to be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms.

PEO2. To prepare graduates to achieve peer-recognition, as an individual and as a team player, through demonstration of good analytical, design, implementation and interpersonal skills.

PEO3. To prepare graduates to contribute to society as broadly educated, expressive ethical and responsible citizens with proven expertise

PEO4. To prepare graduates to pursue life-long learning to fulfil their goals.

PROGRAMME OUTCOMES (PO'S):

(To be achieved by the student after every semester/year/and at the time of graduation) At the end of this program, graduates will be able to :

1. Computer knowledge: Apply the knowledge of mathematics, computer Fundamentals to IT applications.

2. Design/Development of solutions: Design solutions for IT applications using latest technologies and develop and implement the solutions using various latest languages.

3. Modern tool usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex IT applications with an understanding of the limitations.

4. Environment and sustainability: Understand the impact of the IT analyst solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.

5. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

6. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PROGRAMME SPECIFIC OUTCOMES (PSO'S):

PSO-1: Apply mathematical, conceptual knowledge of computing and analytical skills to demonstrate data analytics of real-world applications.

PSO-2: Hands-on experience with appropriate data analytics tools to enhance their knowledge in the field of data science.

PSO-3: Equipped with creative and technical skills in various domains of Data Handling, Predictive Modelling and Data Visualization.

EMPLOYBILITY:

1. Data Analyst: Data analysts interpret data to help organizations make strategic decisions. They collect, process, and analyze data sets to provide insights and recommendations.
2. Data Scientist: Data scientists use advanced statistical and analytical techniques to interpret complex data sets. They develop algorithms and predictive models to extract valuable insights and solve business problems.
3. Business Intelligence Analyst: Business intelligence analysts analyze data to help companies improve decision-making processes. They create reports, dashboards, and visualizations to communicate insights to stakeholders.
4. Machine Learning Engineer: Machine learning engineers design and implement machine learning algorithms and models. They work on projects such as natural language processing, computer vision, and recommendation systems.
5. Data Engineer: Data engineers design, build, and maintain data pipelines and infrastructure. They ensure data availability, reliability, and scalability for analytical and operational needs.

6. Quantitative Analyst: Quantitative analysts, or quants, develop mathematical models and algorithms for financial markets and investment strategies. They use statistical techniques to analyze market data and forecast trends.
7. Research Scientist: Research scientists conduct scientific research using data analysis techniques. They work in various fields such as healthcare, environmental science, and social science to discover new insights and solve complex problems.
8. Data Consultant: Data consultants provide expertise and guidance to organizations on data-related projects. They assess data needs, develop strategies, and implement solutions to improve business processes and outcomes.
9. Data Journalist: Data journalists analyze and visualize data to create compelling stories and reports. They use data-driven techniques to uncover trends, patterns, and insights for storytelling in journalism.

SEMESTER I

COURSE TITLE: ENGLISH COMPOSITION AND COMMUNICATION

COURSE OBJECTIVE:

1. To train and prepare the students to seek and find employment in various field.
2. To develop communicative competence in students
3. To impart knowledge, ideas and concepts in the technicalities of proper pronunciation, structure, appropriate use and style of the English language as well as the application areas of English Communication.
4. To expose the students to the employment opportunities, challenges and job roles.

COURSE OUTCOME:

At end of the course students would be able to:

1. understand communication skills of English language
2. Formulate/ compose his own sentences and able to speak English Language.
3. collaborate with others students in English.
4. communicate properly their ideas and concepts in English.

Unit	Content
Unit 1:	○ Articles ○ Prepositions ○ Tenses ○ Subject – Verb Agreement **(6 Hours)**
Unit 2:	○ Meeting People ○ Exchanging Greetings and Taking Leave ○ Introducing Yourself **(6 Hours)**
Unit 3: Prose	○ The Home Coming – Rabindranath Tagore ○ A Lesson My Father Taught Me – APJ Abdul Kalam ○ How I Became a Public Speaker – George Bernard Shaw **(6 Hours)**
Unit 4: Poetry	○ The quality of Mercy – William Shakespeare ○ The Mountain and the Squirrel – R.W. Emerson ○ Where the Mind is Without Fear – Rabindranath Tagore **(6 Hours)**
Unit5: Skill Enhancement	○ Spot Visit and preparing a report – Visit to Super Market, Bus Stand, Railway Station, Bank, Medical Shop, Bakery etc. ○ Interview of a dignitary and writing a report in dialogue form **(6 Hours)**

TEXT BOOK:

Pathmaker: A Textbook for College Students [ISBN 989354421778] Edited by Board of Editors, SantGadge Baba Amravati University, Amravati. Publisher : Orient BlackSwan Pvt Ltd

COURSE TITLE: MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

COURSE OBJECTIVE:

1. To understand the concepts of matrices and calculus in data science
2. To solve problems in sets and foundations in logic.
3. To infer the relations and functions in sets
4. To perform hypothesis testing.
5. To apply the concepts of probability in data science.

COURSE OUTCOME:

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

1. Interpret the concepts of matrices and calculus in data science.
2. Infer problems in sets and foundations in logic.
3. Solve the relations and functions in sets.
4. Use hypothesis testing for calculating Type I and Type II errors.
5. Relate the concepts of probability in data science.

Unit	Content
Unit 1: Matrices And Calculus	Matrices as a way of organizing data – Matrices as images –Matrix operations – Identity matrix, inverses and determinants – Vector operations – Dot products -Introduction to Calculus- Applications of Calculus- Calculus Notation- Linear Functions- Derivative- Exponential & Logarithm Rule- Sine and Cosine Functions-Sigmoid Function- Differentiation- Partial Differentiation- Integration **(6 Hours)**
Unit 2: Sets And Foundation in Logics	Sets – Complex numbers – Counting and elementary combinations – Cardinality – Proof Methods –Quantified statements – Indirect argument – Mathematical Induction –Logic – Automated reasoning **(6 Hours)**
Unit 3: Relations And Functions	Relations on sets – Reflexivity, symmetry and transitivity – Functions ongeneral sets – Examples of real functions – Composition of functions – one -to-one, onto and inverse functions – Real functions **(6 Hours)**
Unit 4: Hypothesis Testing	Hypothesis – Significance level and p-value –Type I and Type II Errors –Confidence interval and margin of errors – Calculating sample size and power –Performing hypothesis test – t-test and t-distribution **(6 Hours)**
Unit 5: Probability Theory	Probability Basics – Calculating Simple Probabilities –Rule of Addition – Rule of Multiplication –Bayes Theorem – Expected value – Law of large numbers –Central limit theorem. **(6 Hours)**

TEXT BOOKS:-

1. H. Anton, "Elementary Linear Algebra ", John Wiley, 2014.
2. Zealure C Holcomb, "Fundamentals of Descriptive Statistics", Khanna Publishers, 2015.
3. Kandasamy S. Chand," Numerical Methods", S. Chand publisher, 2008.

REFERENCE BOOKS:-

1. Sheldon Axler, "Linear Algebra Done Right", Springer Nature; 3rd ed. 2015.
2. Peter Goos, David Meintrup, "Statistics with JMP: Graphs, Descriptive Statistics and Probability", Wiley, 2015.

COURSE TITLE: BASICS OF DATA SCIENCE

COURSE OBJECTIVE:

To provide strong foundation for data science and application area related to information technology and understand the underlying core concepts and emerging technologies in data science

COURSE OUTCOME:

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

1. Explore the fundamental concepts of data science
2. Understand data analysis techniques for applications handling large data
3. Understand basic building blocks used in data science process
4. Visualize and present the inference using various tools

Unit	Contents
Unit-1-Introduction To Data Science	Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist? - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modelling – Presentation. **(9 Hours)**
Unit-2 -Big Data	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. **(9 Hours)**
Unit-3-Machine Learning	Machine learning – Modelling Process – Training model – Validating model – Predicting new observations –Supervised learning algorithms – Unsupervised learning algorithms. **(9 Hours)**
Unit-4-Deep Learning	Introduction – Deep Feedforward Networks – Regularization – Optimization of Deep Learning – Convolutional Networks – Recurrent and Recursive Nets – Applications of Deep Learning. **(9 Hours)**
Unit-5 - Data Visualization	Introduction – Benefits of Data Visualization – Types of Data Visualization – Techniques – Process Workflow – Data Visualization Tools. **(9 Hours)**

TEXT BOOKS:

- Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, ManningPublications Co., 1 st edition, 2016
- An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1 st edition, 2013
- Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 1 st edition,2016
- Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O' Reilly, 1 st edition,2018

REFERENCE BOOKS:

- Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1 st edition,2015
- Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1 st edition, 2013

COURSE TITLE: COMPUTER ARCHITECTURE

COURSE OBJECTIVE:

1. To understand the basic Computer architecture
2. To familiarize with arithmetic and logic unit and implementation of different
3. arithmetic operations.
4. To understand the concept of pipelining and parallelism
5. To know the difference types of memory and related performance issues.
6. To understand the concepts of Memory and IO devices.

COURSE OUTCOME:

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

1. Identify the component of the basic computer architecture.
2. Demonstrate binary operations in ALU
3. Demonstrate theoretically the concept of pipelining and parallelism.
4. Appreciate the difference between Cache and Virtual memory and related performance issues.
5. Value the performance difference between and different memory devices and IO.

Unit	Content
Unit1: Introduction	Eight ideas – Components of a computer system – Technology – Performance – Power wall –Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Addressing and addressing modes. **(9 Hours)**
Unit2: Arithmetic For Computers	ALU - Integer Addition, Integer Subtraction, Dealing/Detecting with Overflow - Designing ALU for MIPS, Multiplication- Multiply Algorithm-Optimized Multiplier-Faster Multiplier, Division-Divide Algorithm-Optimized Divider – Floating Point Operations-Standard- IEEE Floating-Point Format. **(9 Hours)**
Unit3: MIPS & Pipelining	Basic MIPS implementation – Building data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions**(9 Hours)**
Unit4: Instruction Level Parallelism	Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors**(9 Hours)**
Unit5: Memory And I/O	Memory hierarchy - Cache Memory - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors. **(9 Hours)**

TEXT BOOKS:

David A. Patterson and John L. Hennessy, “Computer organization and design’, Morgan Kaufmann / Elsevier, Fifth edition

REFERENCE BOOKS:

1. William Stallings, “Computer Organization and Architecture”, Tenth Edition, Pearson Education, 2016.
2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, “Computer Organisation”, VI th edition, Mc Graw-Hill Inc, 2012.
3. Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, Second Edition, Pearson Education, 2005.

COURSE TITLE: STRUCTURED PROGRAMMING

COURSE OBJECTIVE:

1. To acquire the basic knowledge in computer programming
1. To Learn Problem-solving techniques using Programming.
2. To learn the fundamentals of C programming.
3. To gain knowledge in Functions, arrays and strings in C programming.
4. To understand the pointers, Structures and Union in C programming
5. To gain Knowledge on Embedded Programming.

COURSE OUTCOME:

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

1. Describe the basics of digital computer and programming languages.
2. Demonstrate problem solving techniques using flowchart, algorithm/pseudo
3. code to solve the given problem.
4. Design and Implement C program using Control Statements and Functions.

5. Design and Implement C program using Pointers and File operations.
6. Identify the need for embedded C in real-time applications.

Unit	Content
Unit 1: Programming Languages and Problem Solving Techniques	Introduction – Fundamentals of digital computers - Programming languages - Programming Paradigms – Types of Programming Languages – Language Translators – Problem Solving Techniques: Algorithm – Flow Chart - Pseudo code. **(9 Hours)**
Unit 2: Fundamentals Of C	Evolution of C -Why C language - Applications of C language - Data Types in C –Operators and Expressions – Input and Output statements in C – Decision Statements – Loop Control Statements**(9 Hours)**
Unit 3: Functions, Arrays and Strings	Functions – Storage Class – Arrays – Strings and standard functions - Pre-processor Statements. **(9 Hours)**
Unit 4: Pointers, Structures and Union	Pointers – Dynamic Memory allocation – Structure and Union – Files. **(9 Hours)**
Unit 5 : Introduction to Embedded C	Structure of embedded C program - Data Types - Operators - Statements - Functions - Keil C Compiler. **(9 Hours)**

TEXT BOOKS:

1.Jeyapoovan T, “Fundamentals of Computing and Programming in C”, Vikas Publishing house, 2015.
2.Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications, 2014.

REFERENCE BOOKS:

1. Ashok Kamthane, “Computer Programming”, Pearson Education, 7th Edition, Inc 2017.
2. Yashavant Kanetkar, “Let us C”, 15th edition, BPP publication, 2016.

COURSE TITLE: STRUCTURED PROGRAMMING - LAB

NOTE:

- Based on 1DA5.
- The list suggests the program set. Hence, the concerned staff may modify the list as needed (minimum 13).

LIST OF PROGRAMS:

1. Drawing Flowcharts using E- Chart & Writing pseudo code for the following problems

(i) Greatest of three numbers
(ii) Sum of N numbers
(iii) Computation of nCr

2. Fundamentals of C

(i) Program to illustrate arithmetic and logical operators
(ii) Program to read and print data of different types
(iii) Program to calculate area and volume of various geometrical shapes
(iv) Program to compute biggest of three numbers

3. Function, Arrays and Strings

(i) Program to compute Factorial, Fibonacci series and sum of n numbers using recursion

(ii) Program to compute sum and average of N Numbers stored in an array
(iii) Program to sort the given n numbers stored in an array
(iv) Program to search for the given element in an array

4. Pointers, Structures and Union

(i) Program to compute sum of integers stored in a 1-D array using pointers and dynamic memory allocation
(ii) Program to read and print records of a student/payroll database using structures
(iii) Program to simulate file copy
(iv) Program to illustrate sequential access file
(v) Program to illustrate random access file

COURSE TITLE: DATA ANALYSIS WITH EXCEL- LAB

COURSE OBJECTIVE:

1. To explain the fundamental concept of Data analytics through introduction to excel.
2. To comprehend various data visualization tools available in Excel for data analytics.
3. To learn and perform various research on data and perform predictive analysis.
4. To incorporate various methods of advanced data analytics.
5. To implement various forecasting methods using Excel.

COURSE OUTCOME:

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

1. Implement the fundamental concepts of Data Analytics and work with MS Excel. Infer various data visualization tool.
2. Demonstrate various Data driven technique and perform predictive analysis.
3. Perform various advanced data analysis like Cognos Analytics.
4. Create and execute several Forecasting methods using Excel.

LIST OF PROGRAMS:

NOTE:

- The list suggests the program set. Hence, the concerned staff may modify the list as needed (minimum 13).

1. Perform basic spreadsheet tasks including navigation, data entry, and using formulas.
2. Employ data quality techniques to import and clean data in Excel.
3. Create basic charts and pivot charts in Excel.
4. Construct advanced charts and visualizations.
5. Create a CGPA Calculator using Excel and Analyse the result.
6. Perform Data visualization for a Class result and create various Charts.
7. Perform market survey from sample market data from Kaggle and demonstrate the prediction.
8.
9. Analyze data in spreadsheets by using filtering, sorting, look-up functions, and pivot tables.
10. Build dashboards using Excel and Cognos Analytics.
11. Standard Normal Probability Distribution in Excel

TEXT BOOKS:

1. Manisha Nigam, "Advanced Analytics with Excel 2019", BPB 2019.

2. Mark Siegesmund, "Embedded C Programming", first edition, Elsevier publications,2014.

REFERENCE BOOKS :

1. Wanyne. L. Winston, 2014 "Market Analytics Data Driven Technique with Microsoft Excel"

2. David Whigham, 2019, "Business Data Analysis Using Excel", Oxford Publications.

COURSE TITLE: INTRODUCTION TO AI

COURSE OBJECTIVE:

1. Understand the concept of Artificial Intelligence.
2. Learn the basic Mathematics and Statistics concepts used in AI.
3. Understand the effectiveness of machine learning.
4. Identify the AI implementation framework.
5. Apply AI concepts to solve business problems.
6. Solve the problem related to real world application.

COURSE OUTCOME:

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

1. Understand the Academic and Industry perspectives of AI
2. Able to understand the basics of Machine Learning.
3. Grasp the Social Awareness of AI
4. Defend the need for AI in providing solution to business problems
5. Appreciate the application of AI in real world problem solving
6. Learn the concepts of Mathematics used in AI

Unit	Contents
UNIT 1: Introduction to Artificial Intelligence	Definition and scope of Artificial Intelligence. Historical development and milestones. Various approaches to AI: symbolic AI, connectionist AI, etc.**(9 Hours)**
UNIT 2: Deep Learning and Neural Networks	Introduction to artificial neural networks (ANNs) , Basics of deep learning and its applications, Training deep neural networks using frameworks like TensorFlow or PyTorch **(9 Hours)**
UNIT 3: Machine Learning Fundamentals	Introduction to machine learning. Supervised, unsupervised, and reinforcement learning. Model representation and hypothesis space, Model evaluation and performance metrics, Bias-variance trade-off. **(9 Hours)**
UNIT 4: Natural Language Processing (NLP) and AI	Introduction to natural language processing and its challenges, Text preprocessing and feature extraction techniques, Building NLP applications using libraries like NLTK or spaCy. **(9 Hours)**
UNIT 5: AI Implementation Framework	AI development lifecycle. Data preprocessing and feature engineering. Model selection and evaluation. Deployment and maintenance. **(9 Hours)**

TEXT BOOKS:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Introduction to Machine Learning with Python" by Andreas C. Müller and Sarah Guido
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
4. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper

RESOURCES:

 Textbook: "Artificial Intelligence for Business: A Roadmap for Getting Started with AI" by Carlos Guestrin and Andrew Ng

 Supplementary Readings: Academic papers, industry reports, and online articles

 Software Tools: Python programming language, Jupyter Notebooks, scikit-learn, TensorFlow, etc.

COURSE TITLE: DATA SCIENCE ETHICS

COURSE OBJECTIVE:

1. Understand the ethical dimensions of data science and its impact on individuals, society, and organizations.
2. Develop ethical reasoning skills for analyzing and addressing ethical dilemmas in data collection, analysis, and interpretation.
3. Explore legal and regulatory frameworks governing data privacy, confidentiality, and security.
4. Learn to apply ethical principles and guidelines to real-world data science projects.
5. Cultivate awareness of the societal implications of data science practices and technologies.

COURSE OUTCOME:

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

1. Identify ethical considerations and dilemmas in data science projects.
2. Evaluate the ethical implications of data collection, analysis, and decision-making processes.
3. Apply ethical frameworks and principles to address ethical challenges in data science.
4. Communicate effectively about ethical issues in data science to stakeholders.
5. Reflect on the societal impact of data science practices and technologies.

Unit	Contents
UNIT 1: Introduction to Data Science Ethics	Overview of ethical considerations in data science, Introduction to ethical frameworks and principles, Case studies on ethical issues in data science **(6 Hours)**
UNIT 2: Data Collection and Privacy	Ethical considerations in data collection and storage, Legal and regulatory frameworks for data privacy and confidentiality, Privacy-preserving techniques and technologies **(6 Hours)**
UNIT 3: Bias and Fairness in Data Analysis	Understanding bias in data and algorithms, Fairness considerations in machine learning and decision-making, mitigating bias and ensuring fairness in data analysis **(6 Hours)**
UNIT 4: Transparency and Accountability	Importance of transparency and accountability in data science, Ethical considerations in model development and deployment, Strategies for promoting transparency and accountability in data-driven decision-making **(6 Hours)**
UNIT 5: Social Impact and Responsibility	Societal implications of data science practices and technologies, Ethical responsibilities of data scientists and organizations, Case studies on ethical challenges in deploying data science solutions **(6 Hours)**

TEXT BOOKS:

1. "Ethics of Big Data" by Kord Davis and Doug Patterson
2. "Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy" by Cathy O'Neil

ONLINE RESOURCES:

 Data Ethics Club (https://dataethicsclub.org/): Online platform providing resources, case studies, and discussions on data ethics topics.

 The Ethics of AI and Big Data (https://www.edx.org/professional-certificate/ethics-ofai): Online course offered by edX covering ethical issues in AI and big data.

 Fairness and Accountability in Machine Learning (https://fairmlbook.org/): Online book exploring fairness and accountability in machine learning algorithms.

SEMESTER II

COURSE TITLE: COMMUNICATION SKILLS

COURSE OBJECTIVE:

1. To train and prepare the students to seek and find employment in various field.
2. To develop communicative competence in students
3. To impart knowledge, ideas and concepts in the technicalities of proper pronunciation, structure, appropriate use and style of the English language as well as the application areas of English Communication.
4. To expose the students to the employment opportunities, challenges and job roles.

COURSE OUTCOME:

At end of the course students would be able to

1. Understand the paragraph, prose, poetry and communication skills .
2. Formulate/ compose his own sentences and able to speak English Language.
3. Collaborate with others students in English.
4. Communicate properly their ideas and concepts in English.

Unit	Content
Unit 1:	1) Question Tags 2) Synonyms and Antonyms 3) Prefixes, Suffixes, Zero Suffix and Infix **(6 Hours)**
Unit 2:	1) Making Requests and Responding to Requests 22 2) Thanking Someone and Responding to Thanks 3) Developing a Thoughts **(6 Hours)**
Unit 3:	1) On the Rule of the Road – A.G. Gardiner 2) A Simple Philosophy – Seathl 3) The Thief – Ruskin Bond **(6 Hours)**
Unit 4:	1) The World is Too Much With Us – William Wordsworth 2) Love's Philosophy – P.B.Shelley 3) Success is Counted Sweetest – Emily Dickinson **(6 Hours)**
Unit 5:	1) Blog Writing 2) Presentation on a topic from prescribed prose/poem **(6 Hours)**

TEXT BOOKS:-

A Textbook for College Students [ISBN 989354421778] Edited by Board of Editors, Sant Gadge Baba Amravati University, Amravati Publisher : Orient BlackSwan Pvt Ltd

COURSE TITLE: - STATISTICS FOR DATA SCIENCE

COURSE OBJECTIVE:

1. To understand the fundamentals of Statistics Methods
2. To comprehend the concepts of Probability and distribution
3. To interpret simple correlation and Regression analysis
4. To describe sampling inference and testing of hypothesis
5. To gain knowledge on time series and forecasting problems in statistical data

COURSE OUTCOME:

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

1. Deploy concepts of Statistics method to compute averages for statistics data
2. Identify probability value of real-life situation problem by using Probability and distribution concepts 3. Analyze casual relation between two variables by using correlation and regression methods
3. Illustrate significance difference between Null and Alternative Hypothesis for statistical data
4. Recognize the trends between two statistical data by using time series method and solution of forecasting problems.

Unit	Content
Unit 1: Statistical Methods	Introduction to statistics and Data collection – Summarizing and presenting statistical Data – Measures of central tendency – Measures of variation – Measures of skewness and kurtosis **(6 Hours)**
Unit 2: Probability And Distribution	Introduction – Definition of Probability – Basic concepts – Addition law of probability or Theorem of total probability – conditional probability – Bayes' theorem. Random variable – MGF – Distributions - Binomial - Poisson – Uniform – Normal **(6 Hours)**
Unit 3: Correlation And Regression	Introduction – correlation analysis – simple correlation analysis – Rank correlation –Regression analysis CO-1 BTL-3 MODULE 4: SAMPL **(6 Hours)**
Unit 4: Sampling And Large Sample Test	Introduction – Parameters & Statistics – Statistical Inference – Testing of Hypothesis – Null & alternative Hypothesis – LOS- Test of significance of large and small samples – student's t-distribution – Chi – square test – F- distribution. **(6 Hours)**
Unit 5: Statistical Inference	Characteristics of Estimators- Invariance Property of Consistent Estimators- Methods of Estimation- Method of Maximum Likelihood Estimation- Method of Minimum Variance- Confidence Intervals and Confidence Limits- Types of Errors. **(6 Hours)**

TEXT BOOKS:-

1. Richard I. Levin, David S. Rubin, " Statistics for Management ", Seventh Edition, Prentice – Hall of India, 2017.
2. T. Veerarajan," Statistics", Third Edition, McGraw hill, 2008.
3. Dr. B.S.Grewal, "Higher engineering Mathematics", Sixth Edition, Khanna publishers, 2017

REFERENCE BOOKS:-

1 Allen B. Downey, "Think Stats: Exploratory Data Analysis 2nd Edition", O'Reilly publications, 2015.
2 Peter Bruce , Andrew Bruce , Peter Gedeck, "Practical Statistics for Data Scientists", O'Reilly publications, 2020.

COURSE TITLE: - DATABASE MANAGEMENT SYSTEM

COURSE OBJECTIVE:

1. To understand the basics of database system
2. To learn Query Basics and SQL commands
3. To comprehend the concepts of storage structures, form design, usage of report
4. To apprehend the concepts of transaction management and recoverability
5. To gain knowledge on database architecture, directory system and network types.

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COURSE OUTCOME:

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

1. Create a normalized database for an organization.
2. Implement and test database queries for any real time data bases.
3. Formulate and design forms and reports for database applications.
4. Apply transactional management and concurrency control for a database transaction.
5. Recognize the features of client server architecture, distributed architecture, directory system and network types

Unit	Content
Unit 1: Introduction to Database Management System	Advantages and Components of a Database Management Systems - Feasibility Study – Class Diagrams - Data Types - Events - Normal Forms - Integrity - Converting Class Diagrams to Normalized Tables - Data Dictionary. **(12 Hours)**
Unit 2: Queries and Subqueries	Query Basics - Computation Using Queries - Subtotals and GROUP BY Command – Queries with Multiple Tables - Subqueries - Joins - DDL & DML - Testing Queries. **(12 Hours)**
Unit 3: File Storage, Forms and Reports	Storage and File Structure - RAID - File Organization - Indexing and Hashing - B Tree - B Tree Index files - Static and Dynamic Hashing - Effective Design of Forms and Reports - Form Layout - Creating Forms - Graphical Objects - Reports - Procedural Languages - Data on Forms- Programs to Retrieve and Save Data. **(12 Hours)**
Unit 4: Transection And Concurrency Control	Transaction Management – Implementation of Atomicity and Durability – Serializability – Recoverability – Concurrency Control – Dead Lock Handling – Recovery System – Buffer Management. **(12 Hours)**
Unit 5: Database Architecture and Distributed Database	Database – System Architecture – Client Server – Architectures – Parallel System – Network Types – Distributed Database – Homogeneous and Heterogeneous Database – Directory System – Case Study – Oracle – MSSQL Server **(12 Hours)**

TEXT BOOKS:-

1. A. Silberschatz, H.F. Korth and S. Sudharshan, "Database System Concepts" , Fifth Edition, Tata McGraw Hill, New Delhi, 2006.
2. G. V. Post, "Database Management Systems Designing and Building Business Application" ,McGraw Hill International edition, 1999

REFERENCE BOOKS:-

1 J. D. Ullman, "Principles of Database Systems", Galgotia Publishers, Second Edition, New Delhi, 1988
2 C.J. Date, An Introduction to Database Systems, Third Edition, Narosa, New Delhi, 1985

COURSE TITLE: - DATA STRUCTURE AND ALGORITHM

COURSE OBJECTIVE:

Upon completion of the course the students will be able to,

1. To gain knowledge in designing algorithms to solve problems.
2. To understand the concept of linear and nonlinear data structures.
3. To know the concept of various sorting and searching techniques.
4. To acquire knowledge in graph traversal and searching.
5. To apprehend the greedy approach to solve problems.

COURSE OUTCOME:

Upon completion of the course the students will be able to,

1. Compute and Analyze algorithms for efficiency using asymptotic notations.
2. Develop knowledge about basic data structures like arrays, linked list, trees.
3. Solve problems by applying suitable data structure.
4. Define graph and illustrate graph traversal.
5. Design and develop projects requiring implementation of the data structure.

Unit	Content
Unit 1: Introduction	Introduction to Data structures - Algorithms - Algorithm Specifications - Performance analysis - Space Complexity - Time Complexity - Asymptotic Notations - Elementary of Data structures - Stack and Queue - Linked lists - Singly Linked List - Doubly linked list - Linked list-based implementation of Stacks **(9 Hours)**
Unit 2: Trees And Graphs	Trees - Dictionaries - Binary search trees- Priority Queues - Heaps - Heap Sort – Sets and Disjoint Set union - Union and Find operations - Graphs - introduction - definitions – Graph representations. **(9 Hours)**
Unit 3: Sorting And Searching	Sorting Algorithms: Basic concepts - Binary search - Finding the maximum and minimum - Merge sort - Quick sort - Performance measure - Randomized sorting algorithms - Selection sort - Strassen's matrix multiplication. **(9 Hours)**
Unit 4: Algorithm Basics	Fundamentals of Algorithmic Problem Solving - Sorting - Searching - Graphs - Analysis Framework- Asymptotic Notations and Basic Efficiency ClassesAnalysis of Recursive and Non-recursive algorithms. Brute Force - Travelling Salesman Problem, Knapsack Problem, Assignment Problem. Divide and Conquer Approach - Binary Tree Traversals, Multiplication of large Integers, Strassen's Matrix Multiplication. **(9 Hours)**
Unit 5: Dynamic Programming	Dynamic Programming - Warshall's and Floyd's algorithm - Optimal Binary Search Trees- Memory Functions. Representing Graphs - Breadth First Search (BFS) - Depth First Search (DFS) - Single source shortest path - Dijkstra's algorithm - Prim's algorithm - Kruskal's algorithm - Backtracking - n Queen's problem - Hamiltonian Circuit Problem - Subset-Sum Problem - Branch and Bound - Approximation Algorithms -Travelling Salesman Problem, Knapsack Problem. **(9 Hours)**

TEXT BOOKS:-

1. Anita Goel, "Computer Fundamentals", 2nd Edition, Pearson Education, 2012.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017

REFERENCE BOOKS:-

1) 1 Norton Peter, "Introduction to Computers", 4th Edition, TMH, 2001.
2) 2 P. K. Sinha and PritiSinha , "Computer Fundamentals",6th Edition, BPB Publications ,2004.
3) 3 Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, " Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.

COURSE TITLE: PYTHON PROGRAMMING

COURSE OBJECTIVE:

1. To gain knowledge the basic concepts of python programming for data science with relevant Python functions and libraries.
2. To acquire the concepts of user defined modules and packages in python and to have knowledge in the object-oriented programming scenario.
3. To accomplish efficient storage and data operations using NumPy arrays.
4. To handle powerful data operations using Pandas.
5. To perform model building and data analysis with visualization.

COURSE OUTCOME:

1. Identify the need for data science and solve basic problems using Python built-in data types and their methods.
2. Design an application with user-defined modules and packages using OOP Concept.
3. Employ efficient storage and data operations using NumPy arrays.
4. Apply powerful data manipulations using Pandas.
5. Perform data preprocessing and visualization using Pandas

Unit	Content
Unit 1: Introduction To Data Science and Python Programming	introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion-Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types. **(9 Hours)**
Unit 2: File, Exception Handing and OOP	User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance. **(9 Hours)**
Unit 3: Introduction To NumPy	NumPy Basics: Arrays and Vectorized Computation- The NumPy Nd array- Creating Nd arrays- Data Types for Nd arrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing- Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods- Sorting-Unique and Other Set Logic**(9 Hours)**
Unit 4: Data Manipulation with Pandas	Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping-Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format. **(9 Hours)**
Unit 5: Data Cleaning, Preparation and Visualization	Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots. **(9 Hours)**

TEXT BOOKS:

1) Y. Daniel Liang, “Introduction to Programming using Python”, Pearson,2012.
2) Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
3) Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

REFERENCE BOOKS:

1) Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.
2) Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.

COURSE TITLE: DATABASE MANAGEMENT SYSTEM – LAB

NOTE:

- Based on 2DA3
- The list suggests the program set. Hence, the concerned staff may modify the list as needed (minimum 13).

LIST OF PROGRAMS:

1) To study Basic SQL commands (create table, use, drop, insert) and execute the following queries using these commands:

- Create a table 'Emp' with attributes 'ename','ecity','salary','enumber','eaddress','depttname'.
- Create another table 'Company' with attributes 'cname', ccity','empnumber' in the database'Employee'.

2) To study the viewing commands (select, update) and execute the following queries using these commands:

- Find the names of all employees who live in Delhi.
- Increase the salary of all employees by Rs. 5,000.
- Find the company names where the number of employees is greater than 10,000.
- Change the Company City to Gurgaon where the Company name is 'TCS'.

3) To study the commands to modify the structure of table (alter, delete) and execute the following queries using these commands:

- Add an attribute named 'Designation' to the table 'Emp'.
- Modify the table 'Emp', Change the datatype of 'salary' attribute to float.
- Drop the attribute 'depttname' from the table 'emp'.
- Delete the entries from the table 'Company' where the number of employees are less than 500.

4) To study the commands that involve compound conditions (and, or, in , not in, between , not between , like , not like) and execute the following queries using these commands:

- Find the names of all employees who live in 'Gurgaon' and whose salary is between Rs.20,000 and Rs. 30,000.
- Find the names of all employees whose names begin with either letter 'A' or 'B'.
- Find the company names where the company city is 'Delhi' and the number of employees is not between 5000 and 10,000.
- Find the names of all companies that do not end with letter 'A'.

5) To study the aggregate functions (sum, count, max, min, average) and execute the following queries using these commands:

- Find the sum and average of salaries of all employees in computer science department.
- Find the number of all employees who live in Delhi.
- Find the maximum and the minimum salary in the HR department.

6) To study the grouping commands (group by, order by) and execute the following queries using these commands:

- List all employee names in descending order.
- Find number of employees in each department where number of employees is greater than 5.
- List all the department names where average salary of a department is Rs.10,000.

7) To study the commands involving data constraints and execute the following queries using these commands:

- Alter table 'Emp' and make 'enumber' as the primary key.
- Alter table 'Company' and add the foreign key constraint.
- Add a check constraint in the table 'Emp' such that salary has the value between 0 and Rs.1,00,000
- Alter table 'Company' and add unique constraint to column cname
- Add a default constraint to column ccity of table company with the value 'Delhi'

8) To study the commands for joins (cross join, inner join, outer join) and execute the following queries using these commands:

- Retrieve the complete record of an employee and its company from both the table using joins.
- List all the employees working in the company 'TCS'.

9) To study the various set operations and execute the following queries using these commands:

- List the enumber of all employees who live in Delhi and whose company is in Gurgaon or if both conditions are true.
- List the enumber of all employees who live in Delhi but whose company is not in Gurgaon.

10) To study the various scalar functions and string functions (power, square, substring, reverse,upper, lower, concatenation) and execute the following queries using these commands:

- Reverse the names of all employees.
- Change the names of company cities to uppercase.
- Concatenate name and city of the employee.

11) To study the commands involving indexes and execute the following queries:

- Create an index with attribute ename on the table employee.
- Create a composite index with attributes cname and ccity on table company.
- Drop all indexes created on table company.

12) To study the conditional controls and case statement in PL-SQL and execute the following queries:

- Calculate the average salary from table 'Emp' and print increase the salary if the average salary is less that 10,000.
- Display the deptno from the employee table using the case statement if the deptname is'Technical' then deptno is 1, if the deptname is 'HR' then the deptno is 2 else deptno is 3.

13) To study procedures and triggers in PL-SQL and execute the following queries:

- Create a procedure on table employee to display the details of employee to display the details of employees by providing them value of salaries during execution.
- Create a trigger on table company for deletion where the whole table is displayed when delete operation is performed.

14) Consider the tables given below. The primary keys are made bold and the data types are specified.

PERSON(driver_id:string , name:string , address:string)
CAR(regno:string , model:string , year:int)
ACCIDENT(report_number:int , accd_date:date , location:string)
OWNS(driver_id:string , regno:string)
PARTICIPATED(driver_id:string , regno:string , report_number:int ,damage_amount:int)

- Create the above tables by properly specifying the primary keys and foreign keys.
- Enter at least five tuples for each relation.
- Demonstrate how you
- Update the damage amount for the car with specific regno in the accident with report number 12 to 25000.
- Find the total number of people who owned cars that were involved in accidents in the year 2008.
- Find the number of accidents in which cars belonging to a specific model were involved.

COURSE TITLE: PYTHON PROGRAMMING - LAB
LIST OF PROGRAMS:

NOTE:

- Based on 2DA5
- The list suggests the program set. Hence, the concerned staff may modify the list as needed (minimum 13).

Introduction

a) Implement basic Python programs for reading input from console.
b) Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set
c) Solve problems using decision and looping statements.
d) Apply Python built-in data types: Strings, List, Tuples, Dictionary, Set and their methods to solve any given problem.

File Handling

a) Create packages and import modules from packages.
b) Perform File manipulations- open, close, read, write, append and copy from one file to another.
c) Handle Exceptions using Python Built-in Exceptions
d) Solve problems using Class declaration and Object creation.

Numpy

a) Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
b) Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
c) Computation on NumPy arrays using Universal Functions and Mathematical methods.

COURSE TITLE: DATA STRUCTURE – LAB

NOTE:

- Based on 2DA4.
- The list suggests the program set. Hence, the concerned staff may modify the list as needed (minimum 13).

LIST OF PRACTICALS :

1. Implementing basic operations on arrays: insertion, deletion, searching.

2. Implementing linked lists: singly linked list, doubly linked list.

3. Implementing stack and queue using arrays and linked lists.

4. Implementing tree traversal algorithms: preorder, inorder, postorder.

5. Implementing binary search trees (BST) and operations: insertion, deletion, searching.

6. Implementing sorting algorithms: selection sort, bubble sort, insertion sort.

7. Implementing searching algorithms: linear search, binary search.

8. Implementing graph representation: adjacency matrix, adjacency list.

9. Implementing graph traversal algorithms: depth-first search (DFS), breadth-first search (BFS).

10. Implementing shortest path algorithms: Dijkstra's algorithm, Bellman-Ford algorithm.

COURSE TITLE: ENVIRONMENTAL ETHICS

COURSE OBJECTIVE:

1. Understand the philosophical foundations of environmental ethics.
2. Analyze ethical theories and principles as they apply to environmental issues.
3. Evaluate the ethical dimensions of human impacts on the environment.
4. Explore the role of values, attitudes, and cultural perspectives in shapingenvironmental ethics
5. Develop critical thinking and decision-making skills for addressing environmentalchallenges.

COURSE OUTCOME:

1. Identify and describe key concepts and theories in environmental ethics.
2. Critically analyze ethical arguments and perspectives on environmental issues.
3. Apply ethical principles and frameworks to evaluate human interactions with theenvironment.
4. Demonstrate awareness of the interconnectedness of environmental, social, andeconomic systems.
5. Engage in informed dialogue and ethical decision-making regarding environmentalproblems and solutions.

Unit	Content
Unit 1: Foundations of Environmental Ethics	Introduction to Environmental Ethics, Philosophical Perspectives: Anthropocentrism,Biocentrism, Ecocentrism Ethical Theories: Utilitarianism, Deontology, VirtueEthics, Environmental Justice and Equity **(6 Hours)**
Unit 2: Human Impacts on the Environment	Environmental Degradation: Pollution, Deforestation,Habitat Loss, Climate Change: Causes, Impacts, Mitigation Strategies,Biodiversity Conservation and Preservation, Sustainable Development and Resource Management **(6 Hours)**
Unit 3: Ethics of Environmental Policy and Governance	Environmental Policy and Regulation, Environmental Economics: Cost-Benefit Analysis,Externalities, Environmental Law and Legal Rights for Nature,Corporate Social Responsibility **(6 Hours)**
Unit 4: Cultural Perspectives and Indigenous Knowledge	Indigenous Environmental Ethics and TraditionalEcological Knowledge (TEK), Cultural Values and Environmental Attitudes, Environmental Ethics in Religious and SpiritualTraditions, Environmental Education and Awareness **(6 Hours)**
Unit 5: Ethical Decision-Making and Action	Ethical Leadership and Advocacy, Citizen Engagement and Environmental Activism,Ethics of Sustainability: Individual and Collective Responsibilities, Case Studies and Ethical Dilemmas in Environmental Ethics **(6 Hours)**

REFERENCE BOOKS:

"Environmental Ethics: An Introduction" by Joseph R. DesJardins

"Environmental Ethics: Readings in Theory and Application" by Louis P. Pojman and Paul Pojman