Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus

Second Year B. Tech

Computer Science and Engineering(Data Science)

With effect from Year 2022-23

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405
Ph: 02563 259802, Website: www.rcpit.ac.in

R. C. PATEL
INSTITUTE OF TECHNOLOGY
An Autonomous Institute

R. C. Patel Institute of Technology, Shirpur

Institute Vision

To become a leading Institute in Technical education fostering innovation, research, ethical values, and sustainable development for the betterment of society.

Institute Mission

To impart high quality Technical Education through:

M1: Innovative and Interactive learning process and high quality, globally recognized instructional programs.

M2: Fostering a collaborative scientific temper among students with ethical responsibility towards the society.

M3: Preparing students from diverse backgrounds to have aptitude for employment, entrepreneurship and research with a spirit of professionalism.

M4: To contribute to nation's sustainable development.

Department of Computer Science & Engineering (Data Science)

Department Vision

To provide cutting-edge Computer Engineering education in Data Science while instilling socio-moral values.

Department Mission

M1: To deliver state-of-the-art, ICT-enabled teaching and learning to achieve excellence in Data Science education.

M2: To develop professionally competent Data Science Engineers, meeting evolving industrial and societal needs.

M3: To prepare employable professionals with ethical values and a commitment to professional and social responsibility.

Program Educational Objectives (PEOs) of the Department

PEO1: Graduates will achieve proficiency in Data Science and pursue lifelong learning to advance as professionals, entrepreneurs, and leaders.

PEO2: Graduates will operate effectively in diverse, dynamic professional and cultural environments, respecting societal perspectives.

PEO3: Graduates will demonstrate ethical values and social responsibility in their professional and personal lives.

Program Specific Outcomes (PSOs) of the Department

PSO1: Apply programming concepts, algorithms, and data structures to develop data-driven software and web solutions.

PSO2: Develop intelligent solutions using machine learning, data analysis, and cloud technologies for practical problem-solving.

Second Year B. Tech Computer Science and Engineering (Data Science) Semester-III(w.e.f. 2022-23)

Sr	Course Category	Course Code	Course Title	Teaching Scheme				Evaluation Scheme							
								Continuous Assessment (CA)				ESE	Total		
								TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)				
				L	T	P	Credits	[A]			[B]	[C]	[A+B+C]	Credits	
1	BS	BSCS3010T	Mathematics for Intelligent Systems	3	1		4	20	15	15	15	65	100	4	4
2	PC	PCCS3020T	Data Structures and Algorithms	3			3	20	15	15	15	65	100	3	4
	PC	PCCS3020L	Data Structures and Algorithms Laboratory			2	1	25				25	50	1	
3	PC	PCCS3030T	Foundations of Data Analysis	3			3	20	15	15	15	65	100	3	4
	PC	PCCS3030L	Foundations of Data Analysis Laboratory			2	1	25				25	50	1	
4	PC	PCCS3040T	Database Management Systems	3			3	20	15	15	15	65	100	3	4
	PC	PCCS3040L	Database Management Systems Laboratory			2	1	25				25	50	1	
5	PC	PCCS3050T	Statistics for Data Science	3			3	20	15	15	15	65	100	3	4
	PC	PCCS3050L	Statistics for Data Science Laboratory			2	1	25				25	50	1	
6	PC	PCCS3060L	Programming with Python Laboratory			2	1	25				25	50	1	1
7	PJ	PJCS3070L	Semester Project-I			2	1	25				25	50	1	1
8	MC	MCCS3080T	Constitution of India	1										Audit Course	
			Total	16	1	12	22	250			75	475	800	22	22

Prepared by:
Dr. P. S. Sanjekar

Checked by:
Prof. S. P. Salunkhe

Prof. Dr. U. M. Patil
BOS Chairman

Prof. S. P. Shukla
C.O.E.

Prof. Dr. P. J. Deore
Dean Academics/Dy. Director

Prof. Dr. J. B. Patil
Director

R. C. Patel Institute of Technology, Shirpur
SES
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Autonomous

Second Year B. Tech Computer Science and Engineering (Data Science) Semester-IV(w.e.f. 2022-23)

Sr	Course Category	Course Code	Course Title	Teaching Scheme				Evaluation Scheme							
								Continuous Assessment (CA)				ESE	Total		
								TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Best of (TT1 & TT2)				
				L	T	P	Credits	[A]			[B]	[C]	[A+B+C]	Credits	
1	PC	PCCS4010T	Programming Language Principles	3			3	20	15	15	15	65	100	3	4
	PC	PCCS4010L	Programming Language Principles Laboratory			2	1	25				25	50	1	
2	PC	PCCS4020T	Machine Learning - I	3			3	20	15	15	15	65	100	3	4
	PC	PCCS4020L	Machine Learning - I Laboratory			2	1	25				25	50	1	
3	PC	PCCS4030T	System Fundamentals	3			3	20	15	15	15	65	100	3	4
	PC	PCCS4030L	System Fundamentals Laboratory			2	1	25				25	50	1	
4	PC	PCCS4040T	Design and Analysis of Algorithms	3			3	20	15	15	15	65	100	3	4
	PC	PCCS4040L	Design and Analysis of Algorithms Laboratory			2	1	25				25	50	1	
5	HM	HMCS4050T	Universal Human Values	2			2	20	15	15	15	65	100	2	2
6	PC	PCCS4060L	Web Engineering Laboratory			4	2	50				50	100	2	2
7	PJ	PJCS4070L	Semester Project-II			2	1	25				25	50	1	1
8	HM	HMCS4080	Employability Skill Development Program-I			2	1	50					50	1	1
			Total	14		16	22	325			75	500	900	22	22

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Director

Semester - III

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Mathematics for Intelligent Systems (BSCS3010T)		

Prerequisite: Concepts of basic matrices, partial derivatives and basic probability.

Course Objective(s):

To build the strong foundation in learners of mathematics needed for building concepts of machine learning.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze probability of random variables and probability distributions.	L4	Analyze
CO2	Use knowledge of linear algebra.	L3	Apply
CO3	Apply concepts of matrix theory.	L3	Apply
CO4	Apply concepts of calculus.	L3	Apply
CO5	Analyze different optimization techniques.	L4	Analyze

Mathematics for Intelligent Systems(BSCS3010T) Course Contents

Unit-I Probability, Random Variables and Probability Distributions 10 Hrs.

Probability: Conditional Probability, Mutually and Pair Wise Independent Events, Bayes' Theorem

Random Variables: Discrete Random Variable, Probability Mass Function, Discrete Distribution Function, Continuous Random Variable, Probability Density Function, Continuous Distribution Function, Mathematical Expectation, Moment Generating Function, Two-Dimensional Random Variable and its Joint Probability Mass and Density Function, Marginal Distribution Function, Conditional Distribution Functions, Covariance, Joint Moments.

Probability Distributions: Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution.

Continuous Probability Distribution: Uniform Distribution, Exponential Distribution, Normal Distribution, Beta Distribution, Gamma Distribution, Central Limit Theorem.

Unit-II Linear Algebra 08 Hrs.

Vectors in N-Dimensional Vector Space, Properties, Dot Product, Cross Product, Norm and Distance,Vector Spaces over Real Field, Properties of Vector Spaces over Real Field, Subspaces, Linear Independence and Dependence of Vectors, Span of Vectors, Basis of a Vector Space, Dimension of a Vector Space, Cauchy Schwarz Inequality, Linear Transformation, Norms and Spaces, Orthogonal Compliments and Projection Operator, Kernel Hilbert Spaces.

Unit-III Matrix Theory 08 Hrs.

Characteristic Equation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Examples Based on Verification of Cayley Hamilton Theorem, Similarity of Matrices, Diagonalization of Matrices, Functions of Square Matrix, Derogatory and Non-derogatory Matrices, Least Squared and Minimum Normed Solutions.

Unit-IV Calculus 04 Hrs.

Gradient, Directional Derivatives, Jacobian, Hessian, Convex Sets, Convex Functions and its Properties.

Unit-V Optimization 12 Hrs.

Unconstrained and Constrained Optimization, Convergence.

Unconstrained Optimization Techniques: Newton's Method, Quasi Newton Method.

Constrained Optimization Techniques: Gradient Descent, Stochastic Gradient Descent, Penalty Function Method, Lagrange Multiplier Method, Karush–Kuhn–Tucker Method, Simplex Method, Penalty and Duality, Dual Simplex Method, Downhill Simplex Method.

List of tutorials: (any 8)

1. To solve numerical on discrete probability distributions.
2. To solve numerical on continuous probability distributions.
3. To solve numerical on vector spaces (basis and dimension).
4. To solve numerical on cauchy-schwarz inequality and linear transformation.
5. To solve numerical on diagonalizability using eigenvalues and eigenvectors.
6. To solve numerical on minimal polynomial and functions of a matrix.
7. To solve numerical on calculus.
8. To solve numerical on Gradient descent and Lagrange's multiplier method.
9. To solve numerical on KKT method.
10. To solve numerical on all forms of simplex method.

Any other tutorial based on syllabus may be included which would help the learner to understand topic/concept.

Text Books:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 44^{th} Edition, Khanna Publication, 1965.
2. Kanti B. Datta, "Mathematical Methods in Science and Engineering", 1^{st} Edition, Cengage Learning India, 2011.
3. Hamdy A. Taha, "Operations Research - An Introduction", Pearson, 10^{th} Edition, 2010.
4. Kanti Swarup, P. K. Gupta, Mohan Man, "Operations Research", 2020 Edition, S Chand Publication, 2005.

Reference Books:

1. W. Cheney, "Analysis for Applied Mathematics", 1^{st} Edition, New York: Springer Science+Business Media, 2001.
2. S. Axler, "Linear Algebra Done Right", 3^{rd} Edition, Springer International Publishing, 2015.
3. J. Nocedal and S. J. Wright, "Numerical Optimization", 2^{nd} Edition, New York: Sp Science+Business Media, 2006.

4. J. S. Rosenthal, "A First Look at Rigorous Probability Theory", 2^{nd} Edition, Singapore: World Scientific Publishing, 2006.

5. Seymour Lipschutz and Marc Lipson, "Linear Algebra Schaum's outline series", 4^{th} Edition, Mc-Graw Hill Publication, 2009.

6. Erwin Kreysizg, John Wiley & Sons, Inc, "Advanced Engineering Mathematics", 10^{th} Edition, 2000.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Data Structures and Algorithms (PCCS3020T)		
Data Structures and Algorithms Laboratory (PCCS3020L)		

Prerequisite: Computer Programming (C Programming)

Course Objective(s): The course intends to introduce and familiarize students with data structures, their use in solving real time complex problems and implementation of these data structures. The course also aims to provide mathematical approach for analyzing algorithms using asymptotic notation and for measuring efficiency of algorithms. Finally, the course intends to make students learn various sorting and searching techniques and choose efficient one based on their efficiency.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Make use of various operations like searching, insertion, deletion, traversal, etc. on various data structures.	L3	Apply
CO2	Evaluate appropriate (efficient) sorting, searching, and hashing techniques for a given problem and implement them.	L5	Evaluate
CO3	Choose appropriate (efficient) data structures and algorithms to solve specified problems.	L5	Evaluate
CO4	Evaluate and analyze the efficiency of algorithms based on time and space complexity.	L5	Evaluate
CO5	Develop new solutions for given problems or improve existing ones for better efficiency and optimization.	L6	Create

Data Structures and Algorithms (PCCS3020T)
Course Contents

Unit-I Review and Introduction — 06 Hrs.

Review: Pointers, Structures, Function, Recursion.

Introduction to Data Structures: Need of Data Structures, Types of Data Structures, Abstract Data Type (ADT).

Introduction to Algorithms and Analysis: Need of Writing Algorithm, SDLC (System Development Life Cycle) and role of algorithms, Asymptotic Notation (Big-Oh, Big Omega, Theta Notations), Order of Growth Functions, Complexity Analysis Techniques, Few examples of analysis of algorithms (like Fibonacci, prefix average, etc.)

Unit-II Linked Lists — 06 Hrs.

Basic Concept of Linked List, Comparison of Sequential (Array-based) and Linked Organizations, Dynamic Memory Management, ADT of Linked List, Singly Linked List, Doubly Linked List, Circular Linked List, various basic and Advanced Operations on Linked List (Insertion, Deletion, Merge, Traversal, Copy, Reverse etc.) and their Analysis, Applications of Linked Lists.

Unit-III Stack and Queue — 08 Hrs.

Stacks: Introduction to Stack, Stack as an ADT, Stack ADT Implementation using Array and Linked List with respective Analysis and Comparison, Applications of Stacks: Expression Conversion (Infix to Prefix and Postfix) and Evaluation(Postfix Expression Evaluation), Parenthesis Correctness etc.

Queues: Introduction to Queue, Queue as an ADT, Queue ADT Implementation using Array and Linked List with respective Analysis and Comparison, Linear Queue, Circular Queue, Priority Queue: Heap based Implementation, Deques, Applications of Queues.

Unit-IV Trees — 08 Hrs.

Introduction to Trees, Basic Terminology, Types of Trees, Binary Tree Representation, Traversal of Binary Tree, Expression Tree, Binary Search Tree, Operations on Binary Search Tree and their Analysis, AVL Tree, Applications of Trees.

Unit-V Graphs — 06 Hrs.

Representation of Graph, Types of Graph, Breadth-First Search (BFS), Depth–First Search (DFS), Minimum Spanning Tree: Prim's & Kruskal's Algorithm, Applications of Graphs.

Unit-VI Sorting and Searching Techniques — 08 H

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Radix

Analysis of Sorting Techniques.

Searching: Linear Search, Binary Search, Hashing Techniques and Collision Resolution Techniques, Linear Hashing, Hashing with Chaining, Separate Chaining, Open Addressing, Rehashing, Analysis of Searching Techniques.

Data Structures and Algorithms Laboratory (PCCS3020L)

List of Laboratory Experiments

Suggested Experiments:

1. Recursion
    - Implementation of Recursive Algorithms to Solve Various Fundamental Problems like: Addition of elements in an Array, Reversing an Array, Adding all digits of a given Numeral, Prefix Average, Factorial of a given number, Fibonacci Sequence etc.
2. Sorting and Searching
    - Implementation of Insertion Sort, Selection Sort Menu Driven Program.
    - Implementation of Quick Sort.
    - Implementation of Merge Sort.
    - Implementation of Heap Sort.
    - Implementation of Binary Search.
    - Implementation of Hashing Functions with Different Collision Resolution Techniques.
3. Linked List
    - Implementation of Linked Lists Menu Driven Program.
    - Implementation of different operations on Linked List: Copy, Concatenate, Split, Reverse, Count number of Nodes etc.
    - Implementation of Polynomial Operations (Addition, Subtraction) using Linked List.
4. Stack and Queue
    - Implementation of Infix to Postfix Transformation and its Evaluation Program.
    - Implementation of Infix to Prefix Transformation and its Evaluation Program.
    - Implementation of Double Ended Queue Menu Driven Program.
    - Implementation of Queue Menu Driven Program.
    - Implementation of Circular Queue Menu Driven Program.
    - Implementation of Priority Queue Program using Array.
    - Implementations of Linked Lists Menu Driven Program (Stack and Queue).

- Implementations of Double Ended Queue using Linked Lists.
- Implementation of Priority Queue program using Heap.

5. Trees

   - Implementation of BT (Binary Tree) Program.
   - Implementation of BST Program.
   - Implementation of Various Operations on Tree like: Copying Tree, Mirroring a Tree, Counting the Number of Nodes in the Tree, Counting only Leaf Nodes in the Tree.
   - Implementation of Construction of Expression Tree using Postfix Expression.

6. Graphs

   - Implementation of Graph Menu Driven Program (DFS & BFS).

Note: Students are required to complete 12 experiments. At least one experiment is mandatory from each topic. Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C ", 2^{nd} Edition,Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2^{nd} Edition, W. H. Freeman and Company, 2008.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C ", 4^{th} Edition, Pearson, 2014.
2. M. T. Goodrich, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++ ", Wiley, 2004.
3. Tenenbaum, Langsam, Augenstein, "Data Structures using C ", Pearson, 2004.
4. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Addison-Wesley, 2010.
5. Reema Thareja, "Data Structures using C ", Oxford, 2017.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Foundations of Data Analysis (PCCS3030T)		
Foundations of Data Analysis Laboratory (PCCS3030L)		

Prerequisite: Basic Mathematics

Course Objective(s): To develop skills of data analysis techniques for data modelling.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use visualization techniques to understand data.	L3	Apply
CO2	Use ETL and perform OLAP operations.	L3	Apply
CO3	Analyze various techniques to improve quality of data.	L4	Analyze
CO4	Apply appropriate feature engineering techniques to prepare data for modelling.	L3	Apply
CO5	Use sampling techniques to sample data for modelling.	L3	Apply

Foundations of Data Analysis (PCCS3030T)
Course Contents

Unit-I Data — 06 Hrs.

Data Objects and Attributes: Nominal, Binary, Ordinal, Numeric, Discrete, Continuous. Characteristics of Data Sets: Dimensionality, Sparsity, Resolution. Types of Data Sets: Record Data, Data Matrix, Graph-based Data, Sequential Data, Sequence Data, Time Series Data, Spatial Data.

Data visualization: Temporal: Scatter Plots, Time Series Sequences, Line Graphs; Hierarchical: Tree Diagrams, Ring Charts; Network: Matrix Charts, Node-link Diagrams, Word Clouds, Alluvial Diagrams; Multidimensional: Pie Chart, Venn Diagrams, Stacked Bar Graph, Histograms; Geospatial: Flow Map, Density Map, Heat Maps.

Unit-II ETL Process and OLAP — 08 Hrs.

Major steps in ETL Process, Data Extraction: Techniques, Data Transformation: Basic Tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Analysis, Hypercubes.

OLAP Operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models: MOLAP, ROLAP.

Unit-III Data Preprocessing — 10 Hrs.

Data Quality: Measurement Error, Data Collection Error, Noise, Artifacts, Precision, Bias, Accuracy, Outliers, Missing Values, Inconsistent Values, Duplicate Values.

Data Cleaning: Handling Missing Values and Noisy Data.

Data Transformation: Smoothing, Attribute Construction, Aggregation, Normalization.

Data Discretization: Binning, Histogram analysis, Clustering.

textbfOutlier Detection: Types of Outliers, Challenges, Statistical Method, Proximity-based Method, Clustering-based Method.

Unit-IV Feature Engineering — 10 Hrs

Curse of Dimensionality, **Feature Selection**: Univariate methods (Pearson Correlation, F-Score, Chi-Square, Signal to Noise Ratio) and Multivariate methods (Forward Selection, Backward Selection and Stepwise Selection), **Feature Extraction**: Principal Component Analysis.

Unit-V Elementary Sampling Theory — 08 Hrs.

Census and Sampling Survey, Steps in Sampling Design, Criteria of selecting a good sample procedure, Characteristics of a good Sample design, Types of sample design: Non Probability and Probability Sampling, Complex Random Sampling Design: Symmetric Sampling, Stratified Sampling, C Sampling, Area Sampling, Sequential Sampling and Multi-stage Sampling.

Foundations of Data Analysis Laboratory (PCCS3030L)

List of Laboratory Experiments

Suggested Experiments:(At least 8 experiments)

Visualization experiments can be performed using Tableau and Data Preprocessing experiments can be performed using Python/R.

1. Create new measures on a given dataset and visualize them using a bar graph.
2. Perform time series aggregation, apply filters on a given dataset, create line and area charts.
3. Apply maps, scatter plots on a given dataset and create a dashboard.
4. Perform joins, blends and create dual axis chart.
5. Perform table calculations, bins, distributions and create Heat maps.
6. Create an interactive data story.
7. Perform Exploratory Data Analysis on a given dataset.
8. Perform Data cleaning on a given dataset.
9. Perform necessary Data Transformation on a given dataset.
10. Perform correlation analysis on a given dataset.
11. Perform dimensionality reduction using PCA.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Jason Browniee, "Data Preparation for Machine Learning", Machine Learning Mastery.
2. Jason Osborne, "Best Practices in Data Cleaning: A Complete Guide to Everything you Need to Do Before and After Collecting Your Data", Sage Publication, 2012.
3. Q. Ethan McCallum, "Bad Data Handbook", O'Reilly, 2012.
4. Max Kuhn and Kjell Johnson, "Feature Engineering and Selection: A Practical Approach for Predictive Models", CRC Press, 2020.

Reference Books:

1. Jeffrey Shaffer, Steve Wexler, Andy Cotgreave, "The Big Book of Dashboards: Visualizing your Data using Real-World Business Scenarios", Wiley 2017.

2. C. R. Kothari, "Research Methodology-Methods and Techniques", 2^{nd} Edition, New Age International.

3. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", 12^{th} Edition, Sultan Chand Publisher.

4. Paulraj Ponniah, "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals", 2^{nd} Edition, Wiley.

5. Rayan Sleeper, "Practical Tableau", O'Reilly 2018.

6. Han, Kamber, Morgan Kaufmann, "Data Mining Concepts and Techniques", 3^{rd} Edition.

7. Wes McKinney, "Python for Data Analysis", 2^{nd} Edition, O'Reilly, 2018.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Database Management Systems (PCCS3040T)		
Database Management Systems Laboratory (PCCS3040L)		

Course Objective(s): The course intends to introduce the students to the management of database systems, with an emphasis on how to design, organize, maintain and retrieve information efficiently and effectively from a database.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an optimized database.	L6	Create
CO2	Create and populate a relational database and retrieve information from the database by formulating SQL queries.	L6	Create
CO3	Explain the concepts of transaction, concurrency and recovery.	L2	Understand
CO4	Apply indexing mechanisms for efficient retrieval of information from database.	L3	Apply

Database Management Systems (PCCS3040T)
Course Contents

Unit-I Introduction to Database Concepts — 03 Hrs.

Introduction, Characteristics of Databases, File System v/s Database System, Users of Database System, Data Independence, DBMS System Architecture, Database Administrator.

Unit-II Entity–Relationship Data Model — 08 Hrs.

The Entity-Relationship (ER) Model: Entity Types: Weak and Strong Entity Sets, Entity Sets, Types of Attributes, Keys, Relationship Constraints: Cardinality and Participation.

Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.

Unit-III Relational Model and Relational Algebra — 08 Hrs.

Introduction to the Relational Model, Relational Schema and Concept of Keys, Mapping the ER and EER Model to the Relational Model.

Relational Algebra: Unary and Set Operations, Relational Algebra Queries.

Unit-IV Structured Query Language (SQL) — 09 Hrs.

Overview of SQL, Data Definition Commands, Data Manipulation Commands, Data Control Commands, Transaction Control Commands.

Integrity Constraints: Key Constraints, Domain Constraints, Referential Integrity, Check Constraints, Set and String Operations, Aggregate Function, Group By Clause, Having Clause.

Views in SQL, Joins, Nested and Complex Queries.

Unit-V Relational Database Design — 10 Hrs.

Pitfalls in Relational-Database Designs, Concept of Normalization, Functional Dependencies, First Normal Form, 2NF, 3NF, BCNF.

Transactions Management and Concurrency:

Transaction Concept, Transaction States, ACID Properties, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-Based, Timestamp-Based Protocols.

Recovery System: Introduction to Recovery System.

Unit-VI Indexing Mechanism — 04 Hrs.

Hashing Techniques, Types of Indexes: Single Level Ordered Indexes, Multilevel Indexes,Overview of BTrees and B+ Trees.

Database Management Systems Laboratory (PCCS3040L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. To draw an ER diagram for a problem statement.
2. To implement Basic SQL commands.
3. To access & modify data using SQL.
4. To implement Joins and Views.
5. To implement Subqueries.
6. To implement Integrity Constraints.
7. To implement triggers.
8. To implement procedures, functions and cursors.
9. To simulate ARIES recovery algorithm.
10. To demonstrate export-import commands.
11. To implement B-trees/B+ trees.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 6^{th} Edition, McGraw – Hill.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 5^{th} Edition, Pearson Education.
3. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", 5^{th} Edition, Thomson Learning.
4. Chhanda Ray, "Distributed Database System", Pearson Education India.
5. G. K. Gupta, "Database Management Systems", McGraw – Hill.

Reference Books:

1. Dr. P.S. Deshpande, "SQL and PL/SQL for Oracle 10g, Black Book", Dreamtech Press.
2. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Publication

3. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw – Hill.

4. M. Tamer Ozsu, Patrick Valduriez, "Principles of Distributed Database", 2nd Edition, Pearson Education India.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Statistics for Data Science (PCCS3050T)		
Statistics for Data Science Laboratory (PCCS3050L)		

Prerequisite: Probability, Probability distribution

Course Objective(s): To build the strong foundation in statistics which can be applied to analyze data and make predictions.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Interpret data using descriptive statistics.	L2	Understand
CO2	Use sampling distributions and estimate statistical parameters.	L3	Apply
CO3	Formulate hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO4	Develop analysis of variance on data.	L3	Apply
CO5	Examine relations between data.	L3	Apply

Statistics for Data Science (PCCS3050T)
Course Contents

Unit-I Introduction to Statistics 08 Hrs.

Types of Statistics, Population vs Sample

Measures of Central Tendency: Arithmetic Mean, Properties, Weighted Mean, Properties, Median, Mode, Grouped and Ungrouped Data, Empirical Relation between the Mean, Median and Mode, Geometric Mean, Harmonic Mean, Relation between Arithmetic, Geometric and Harmonic Mean, Outlier.

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Properties, Variance, Root Mean Square Deviation, Empirical Relations between Measures of Dispersion, Absolute and Relative Dispersion, Coefficient of Variation, Moments, Pearson's β and γ Coefficients, Skewness, Kurtosis, Population Parameters and Sample Statistics, Histogram, Frequency Polygon.

Measures of Position: Quartiles, Interquartile Range, Semi Interquartile Range, Percentiles, Percentile Rank, 10–90 Percentile Range, Box and Whisker Plot.

Unit-II Sampling Distribution and Estimation 07 Hrs.

Sampling Distribution: Central Limit Theorem, Population Distribution, Chi-Square Distribution, z-Distribution, Student's t-Distribution, f-Distribution.

Statistical Estimation: Characteristics of Estimators, Consistency, Unbiasedness, Unbiased Estimates, Efficient Estimates, Sufficient Estimators, Point Estimates, Interval Estimates, Determination of Sample Size for Estimating Mean and Proportions, Estimates of Population Parameters, Probable Error.

Unit-III Hypothesis Testing for Data Driven Decision Making 12 Hrs.

Hypothesis testing: Test of Significance, Null and Alternative Hypothesis, Type I and Type II Error, Factors Affecting Type II Error, Probability of Type II Error, Power of Test, p Value, Critical Region, Level of Significance.

Confidence Interval: Population Mean, Difference between Two Population Means, Population Proportion, Difference between Two Population Proportions, Variance, Ratio of Variances of Two Populations. Goodness of Fit Test using Kolmogorov-Smirnov Test and Anderson Darling Test.

Tests using z-Statistics: Difference between Sample Proportion and Population Proportion, Difference between Two Sample Proportion, Difference between Sample Mean and Population Mean with Known σ and Unknown σ, Difference between Two Sample Means, One Tailed and Two Tailed Tests.

Test using t-Statistics: Difference between Sample Mean and Population Mean, Difference between Two Independent Sample Means, Difference between Means from the Same Group.

Test using f-Statistics: Equality of Population Variance.

Test using Chi-Square Statistics: Test of Independence, Goodness of Fit.

Unit-IV Analysis of Variance (ANOVA) for data analysis 07 Hrs.

Sample Size Calculation, One Way ANOVA, POST-HOC Analysis (Tukey's Test), Randomized Block Design, Two Way ANOVA.

Unit-V Examining Relationship 08 Hrs.

Correlation: Scatter Plot, Covariance, Karl Pearson's Coefficient of Correlation, Hypothesis Test for Correlation, Correlation vs Causation, Extreme Data Values, Limits of Correlation Coefficient, Rank Correlation, Spearman's Rank Correlation Coefficient, Repeated Ranks, Partial and Multi Correlation.

Regression: Linear Regression Analysis, Lines of Regression, Regression Coefficients, Scatter Plot with Regression Lines, Hypothesis Test for Regression, Multiple Regression, Coefficient of Determination, Residuals, Collinearity, Influential Observations.

Statistics for Data Science Laboratory (PCCS3050L)

List of Laboratory Experiments

Suggested Experiments:(any 8 using Python)

1. To perform descriptive statistics on data.
2. To visualize descriptive statistics on data.
3. To prove central limit theorem.
4. To study sampling distributions and their parameters.
5. To perform statistical estimation tests on data.
6. To calculate confidence interval for different parameters.
7. To perform goodness of fit using Kolmogorov-Smirnov test and Anderson Darling test.
8. To perform hypothesis test using z statistics.
9. To perform hypothesis test using t statistics.
10. To perform hypothesis test using f statistics.
11. To perform hypothesis test using Chi Square.
12. To perform ANOVA on given data.
13. To perform Correlation on given data.

14. To perform Regression on given data Regression and evaluate the model.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Thomas Haslwanter, "An Introduction to Statistics with Python", 3^{rd} Edition, Springer, 2016.
2. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", 1^{st} Edition, Green Tea Press, 2011.
3. Enrich L. Lehmann, Joseph P. Romano, "Testing Statistical Hypotheses", 3^{rd} Edition, Springer, 2008.
4. S. P. Gupta, "Statistical Methods", 43^{rd} Edition, Sultan Chand, 2014.

Reference Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for data scientists 50+ Essential Concepts Using R and Python", 2^{nd} Edition, O'Reilly Media, Inc, 2020.
2. David Freedman, Robert Pisani, Roger Purves, W. W. Norton, "Statistics", 4^{th} Edition, 2007.
3. S. C. Gupta, V. K. Kapoor, "Fundamentals of mathematical statistics", 10^{th} Edition, Sultan Chand, 2002.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Programming with Python Laboratory (PCCS3060L)		

Prerequisite: Programming Fundamentals

Course Objective(s):

1. To learn the basic and OOP concepts of Python.
2. To study various advance python concept like inheritance, exception handling, modules etc.
3. To learn to develop GUI based standalone and web application.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use basic data types and data structures in Python.	L3	Apply
CO2	Demonstrate the concepts of Object-Oriented Programming.	L3	Apply
CO3	Experiment with file and directory handling, and text processing concepts in Python.	L3	Apply
CO4	Make use of database connectivity and client-server communication using Python.	L3	Apply
CO5	Utilize various advanced modules of Python for data analysis.	L3	Apply

Programming with Python Laboratory (PCCS3060L) Course Contents

Unit-I Python Basics 08 Hrs.

Data Types in Python, Operators in Python, Input and Output, Control Statement, Arrays in Python, String and Character in Python, Functions, List and Tuples, Dictionaries.

Unit-II Introduction to OOP 08 Hrs.

Classes, Objects, Constructor, Methods, Abstraction, Inheritance, Magic Methods, Exception Handling

Unit-III Advanced Python 09 Hrs.

Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders (Python OS Module, Python Datetime Module, Python Math and Random Modules, Text Processing and Regular expression in Python)

Unit-IV Python Integration Primer 08 Hrs.

Graphical User Interface using Tkinter: Form Designing Networking in Python: Client Server Socket Programming, Python Database Connectivity using SQL lite.

Unit-V Python Advance Modules 09 Hrs.

Numpy: Working with Numpy, Constructing Numpy Arrays, Printing Arrays, Arithmetic Operations on Matrix's, Numpy zeros(), Matplotlib: Matplotlib-Installation and Sample Code, Bar Chart Pandas: Data Processing, Pandas-Data structure, Pandas-Series Data, Data Frames

Programming with Python Laboratory (PCCS3060L)

List of Laboratory Experiments

Suggested Experiments:(Any 10)

1. Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2. Demonstrate the concept of Abstraction in Python.
3. Demonstrate the concept of Inheritance.
4. Demonstrate exception handling.
5. Python program to explore different types of Modules

6. Exploring Files and directories -
   (a) Python program to append data to existing file and then display the entire file.
   (b) Python program to count number of lines, words and characters in a file.
   (c) Python program to display file available in current directory
7. Make use of RE module to do text processing.
8. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
9. Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/ MySQL)using python.
10. Creation of simple socket for basic information exchange between server and client.
11. Make use of advance modules of Python like Matplotlib, Numpy, Pandas.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. "Learn Python the Hard Way", Zed Shaw's Hard Way Series, 3rd Edition,2013.
2. "Python Projects", Laura Cassell, Alan Gauld, wrox publication,2015.

Digital Resources:

1. The Python Tutorial, http://docs.python.org/release/3.0.1/tutorial/
2. http://spoken-tutorial.org
3. www.staredusolutions.org

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: III
Semester Project-I (PJCS3070L)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done (Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 3.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Constitution of India (MCCS3080T)		

Course Objective(s):

1. To provide basic information about Indian Constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the historical background, philosophy, and salient features of the Indian Constitution.	L2	Understand
CO2	Interpret the fundamental rights, duties, and directive principles enshrined in the Constitution for responsible citizenship.	L2	Understand
CO3	Describe the structure, roles, and functions of the legislative, executive, and judiciary branches of government.	L2	Understand
CO4	Analyze the federal structure, center-state relations, and constitutional provisions for governance and emergency powers.	L4	Analyze
CO5	Apply constitutional principles to contemporary socio-political and legal issues, fostering ethical and democratic values.	L3	Apply

Constitution of India (MCCS3080T)
Course Contents

Unit-I Introduction to the Constitution of India — 2 Hrs.

The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit-II Directive Principles of State Policy — 3 Hrs.

Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

Unit-III State Executives — 3 Hrs.

Governor, Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42^{nd}, 44^{th}, 74^{th}, 76^{th}, 86^{th} & 91^{st} Amendments.

Unit-IV Special Provisions — 3 Hrs.

For SC & ST Special Provision for Women, Children & Backward Classes, Emergency Provisions.

Human Rights:

Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Cooperative Societies.

Unit-V Scope & Aims of Engineering Ethics — 3 Hrs.

Responsibility of Engineers, Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Text Books:

1. Durga Das Basu, "Introduction to the Constitution on India", Student Edition, Prentice –Hall EEE, 19^{th}/ 20^{th} Edition, 2001.
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins, "Engineering Ethics", Thompson Asia, 2003.

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of Pvt. Ltd. New Delhi, 2004.

3. Brij Kishore Sharma, " Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.

4. Latest Publications of Indian Institute of Human Rights, New Delhi.

Web Resources

1. www.nptel.ac.in
2. www.hnlu.ac.in
3. www.nspe.org
4. www.preservearticles.com

Evaluation Scheme:

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.

Semester - IV

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Programming Language Principles (PCCS4010T)		
Programming Language Principles Laboratory (PCCS4010L)		

Prerequisite: Computer Basics

Course Objective(s):

To introduce various programming paradigms and basic constructs of programming languages with the concepts of syntax and semantics.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare different programming paradigms with their design issues.	L5	Evaluate
CO2	Apply client and server-side scripting to develop applications.	L3	Apply
CO3	Illustrate system programming concepts.	L3	Apply

Programming Language Principles (PCCS4010T) Course Contents

Unit-I Introduction 04 Hrs.

Role of Programming Languages, Need to Study Programming Languages, Characteristics of Programming Languages, Programming Language Paradigms: Imperative, Object Oriented, Functional, Logic, Event Driven and Concurrent Programming, Language Design Issues, Language Translation Issues. Data Types: Properties of Types and Objects, Elementary Data Types, Structured Data Types, Type Conversion, Binding and Binding Times.

Unit-II Imperative Programming Paradigm 08 Hrs.

Procedural Programming: Sequence Control: Implicit and Explicit Sequence Control, Sequencing with Arithmetic Expressions, Sequencing with Non arithmetic Expressions, Sequence Control between Statements. Subprogram Control: Subprogram Sequence Control, Attributes of Data Control, Shared Data in Subprograms, Different Parameter Passing Methods, Lifetime of Variables, Storage Management, Exceptions and Exception Handling. Desirable and Undesirable Characteristics of Procedural Programming. Case Study of C.

Object – Oriented Programming: General Characteristics for Object-Based Programming, Design Principles for Object-Oriented Programming, Implementing Object-Oriented Programming, Desirable Characteristics of Object-Oriented Programming. Object Oriented Programming in Java: Abstraction, Inheritance, Polymorphism, I/O, Access Specification, Interfaces, Packages, Exception Handling, Multithreading, Event Handling. AWT: Working with Windows, Graphics, Text, using AWT Controls, Layout Manager and Menus. Comparative Study of Java and Python.

Unit-III Declarative Programming 08 Hrs.

Logic Programming Language Model, Logical Statements, Resolution, Unification, Search Structures, Applications of Logic Programming. Case Study of Prolog. Applicative Programming Paradigm: Lambda Calculus: Ambiguity, Free and Bound Identifiers, Reductions, Typed Lambda Calculus, Principles of Functional Programming. Case Study of Haskell.

Unit-IV Overview of Scripting Language 04 Hrs

Common Characteristics, Different Problem Domains for using Scripting, Use of Scripting in Web Development-Server and Client-Side Scripting. Innovative Features of Scripting Languages-Names and Scopes, String and Pattern Manipulating, Data Types, Object Orientation.

Unit-V Syntax and Semantics 12 H

Lexical Structure of Programming Languages, Context-Free Grammars and Bnfs, Parse Trees and Abstract Syntax Trees, Ambiguity, Associativity and Precedence, Ebnfs and Syntax Diagrams, Parsing Techniques and Tools, Lexics Vs Syntax Vs Semantics. Attributes, Binding and Semantic Functions, Declarations, Blocks and Scopes, The Symbol Table, Name Resolution and Overloading, Allocation Lifetime and The Environment, Variable and Constants, Aliases, Dangling References and Garbage.

Unit-VI Parallel Programming Paradigm 06 Hrs.

Principles of Parallel Programming, Precedence Graph, Data Parallelism, Control Parallelism, Message Passing, Shared Address Space, Synchronization Mechanisms, Mapping, Granularity.

Programming Language Principles Laboratory (PCCS4010L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. Procedural Programming
    - Write a C program to find whether a triangle can be formed or not. If not display "This Triangle is NOT possible." If the triangle can be formed, then check whether the triangle formed is equilateral, isosceles, scalene or a right-angled triangle. (If it is a right-angled triangle then only print Right-angle triangle do not print it as Scalene Triangle or Isosceles triangle).
    - Write a C program to sort a given 1D array using pointer in ascending order.
2. Object Oriented Programming
    - Implement an application of Encapsulation.
    - Implement an application for different types of Inheritance.
3. Logic Programming: Implement following using PROLOG
    - Write facts for the given statement.
    - Write a program to study rule.
    - Create a family tree.
4. Functional Programming: Implement following using Haskell
    - Write a function to determine the length of a list.
    - Write a function to determine if a given item appears in a list.
    - Write a function to find addition of two number.

- Write a program to find the second lowest grade of any student(s) from the given names and grades of each student using lists and lambda. Input number of students, names and grades of each student.

5. Scripting
   - Implement string and pattern matching using python/PERL.
   - Design Student Registration form using Java Script/PHP.
6. Syntax and Semantics
   - Case study on LEX and YACC Programming.
   - Write a program to identify Tokens.
   - Implement Symbol Table.
7. Parallel Programming
   - Implement inter process communication using RPC.
   - Implement inter process communication using Sockets.
   - Program on multithreading.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept. At least one program per unit should be covered in the laboratory.
Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Roosta Seyed, "Foundations of Programming Languages Design and Implementation", 3rd Edition, Cenage learning.
2. T. W. Pratt, Zelkowitz, "Programming Languages: Design and Implementation", 3rd Edition, PHI, 2002,ISBN-81-203-1038-1.
3. M. Scott, "Programming Language Pragmatics", Morgan Kaufmann Publishers.

Reference Books:

1. R. W. Sebesta, "Concepts of programming languages", 4th Edition, Pearson Education 2001.
2. Sethi Ravi, "Programming Languages: Concepts and Constructs" Pearson Education.
3. Herbert Schildt, "The Complete Reference C", 4th Edition, Tata McGraw Hill.
4. Herbert Schildt, "The Complete Reference Java2", 5th Edition, Tata McGraw Hill.

5. Graham Hutton, "Programming in Haskell", 2^{nd} Edition, Cambridge University Press.

6. John Bloomer, "Power Programming with RPC", O'Reilly.

7. Max Bramer, "Logic Programming with Prolog", Springer

8. M. Lutz, "Learning Python: Powerful Object- Oriented Programming", 5^{th} Edition, O'Reilly.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Machine Learning - I (PCCS4020T)		
Machine Learning – I Laboratory (PCCS4020L)		

Prerequisite: Data Structures, Basic Probability and Statistics

Course Objective(s):

- To introduce the basic concepts and techniques of Machine Learning with designing steps of Machine Learning applications.
- To become familiar with regression, classification and clustering techniques.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain Machine Learning with steps involved in developing machine learning models.	L2	Understand
CO2	Categorize different regression techniques.	L4	Analyze
CO3	Analyze decision tree learning algorithms.	L4	Analyze
CO4	Evaluate Bayesian learning methods.	L5	Evaluate
CO5	Demonstrate Support Vector Machine algorithm.	L3	Apply
CO6	Summarize different clustering techniques.	L2	Understand

Machine Learning - I (PCCS4020T)
Course Contents

Unit-I Introduction to Machine Learning 06 Hrs.

Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps Involved in Developing a Machine Learning Application, Hypothesis and Inductive Bias.

Unit-II Regression 08 Hrs.

Linear Regression, Least Minimum Slope (LMS) Algorithm, Gradient Descent, Lasso and Ridge Regression, Polynomial Regression, Logistic Regression, Maximum Likelihood Function.

Unit-III Trees 08 Hrs.

Introduction to Decision Tree, Learning Decision Tree using ID3 and Gini Index; CART, Overfitting. Ensemble Methods: Bagging (Random Forest) and Boosting (XG Boost).

Unit-IV Classification 06 Hrs

Bayesian Learning, Naive Bayes, Bayesian Network: Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network.

Unit-V Introduction to Support Vector Machine 06 Hrs.

Support Vectors, Functional Margin, Geometric Margin, Optimization Problem, Lagrange Duality, KKT Condition, Maximum Margin with Noise, Non-Linear SVM and Kernel Function.

Unit-VI Clustering 08 Hrs.

K-Means, Adaptive Hierarchal Clustering, Gaussian Mixture Models, Expectation Maximization.

Machine Learning – I Laboratory (PCCS4020L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

Students should be encouraged to write these programs from scratch to develop better understanding of the algorithms. Last 30 minutes of the laboratory should be utilized as a discussion on available python libraries and hyperparameters.

1. Perform Linear Regression.
2. Perform Logistic Regression.

3. Perform Decision Tree using GINI.
4. Perform CART decision tree algorithm.
5. Perform Ensemble methods.
6. Perform Bayesian Classification.
7. Perform Support Vector Machine.
8. Perform K-means clustering.
9. Perform Expectation -Maximization.
10. Mini project based on any machine learning application.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill.
2. Peter Harrington, "Machine Learning In Action", DreamTech Press.
3. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press.

Reference Books:

1. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.
2. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press.
3. Kevin P. Murphy , "Machine Learning — A Probabilistic Perspective".
4. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly.

Weblinks:

1. Towards Data Science: https://towardsdatascience.com
2. Machine Learning — Andrew Ng,Stanford University: https://youtube.com/playlist?list =PLLssT5z_DsKh9vYZkQkYNWcItqhlRJLN
3. Commonly used Machine Learning Algorithms: https://www.analyticsvidhya.com/blog/2017/09/common-machine-learning-algorithms/
4. A Tour to Machine Learning Algorithms: https://machinelearningmastery.com/a-tour-of-machinelearning-algorithms/

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
System Fundamentals (PCCS4030T)		
System Fundamentals Laboratory (PCCS4030L)		

Prerequisite: Basic Mathematics

Course Objective(s):

The objective of this course is to understand the structure, functions and characteristics of computer system and operating systems.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L2	Understand
CO2	Solve problems using appropriate memory mapping, process scheduling, and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Differentiate between various processor architectures.	L2	Understand

System Fundamentals (PCCS4030T)
Course Contents

Unit-I 08 Hrs.

Introduction to System Fundamentals: Von Neumann Model, Fixed Point Representation, Register Transfer and Micro-Operations: Floating Point Representation, Arithmetic Micro-Operations, Arithmetic Logical Shift Unit. Addition and Subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic Operations.

Operating System Architecture: Basic Functions and Services, System Calls, Types of Operating Systems: Batch, Multiprogramming, Multitasking, Time Sharing, Parallel, Distributed & Real -Time O.S., Case Study On Linux OS.

Unit-II 06 Hrs.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Format, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC).

Process Management: Process Concept, Process States, Process Control, Threads, Uni-Processor Scheduling: Types of Scheduling: Pre-Emptive, Non Pre-Emptive, Scheduling Algorithms: FCFS, SJF, RR, Priority.

Unit-III 08 Hrs.

Memory Organization: Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, Cache Coherence, Pentium IV Cache Organization, ARM Cache Organization.

Memory Management: Memory Partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging, Segmentation, Demand Paging and Page Replacement Policies.

Unit-IV 10 Hrs

Concurrency control:

Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer-Consumer Problems and Solutions.

Deadlock: Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher Problem.

Unit-V 04 H

File and I/O Management: File Access Methods, I/O Devices, Organization of I/O Func

Operating System Design Issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache.

Unit-VI 06 Hrs.

Advance Computer Architecture: Characteristics of Multiprocessors, Flynn's Taxonomy, Parallel Processing Architectures and Challenges, Hardware Multithreading, Multicore and Shared Memory Multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse Scale Computers – Introduction to Multiprocessor Network Topologies.

System Fundamentals Laboratory (PCCS4030L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. Explore the internal commands of Linux and Write shell scripts to do the following:
   - Display top 10 processes in descending order.
   - Display processes with highest memory usage.
   - Display current logged in user and logname.
   - Display current shell, home directory, operating system type, current path setting, current working directory.
   - Display OS version, release number, kernel version.
   - Illustrate the use of sort, grep, awk, etc.
2. Implement Booth's multiplication algorithm.
3. Implement Restoring and Non-Restoring division algorithm.
4. Implement Direct memory mapped cache organization.
5. Implement Fully associative and set associative cache memory mapping.
6. Implement various cache/page replacement policies.
7. Implement CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
8. Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
9. Implement Producer -Consumer problem with Semaphore.
10. Implement order scheduling in supply chain using Banker's Algorithm.
11. Implement Disk Scheduling Algorithms.

12. Implement Multithreading.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. William Stallings, "Computer Organisation and Architecture", 8^{th} Edition, Pearson.
2. Greg Gagne, Abraham Silberschatz, Peter B. Galvin ,"Operating System Concepts", 9^{th} Edition, John Wiley & Sons.

Reference Books:

1. John Hayes, "Computer Architecture and Organization", 3^{rd} Edition, McGrawHill.
2. M. Morris Mano, "Computer System Architecture", 3^{rd} Edition, Pearson.
3. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", 6^{th} Edition, PHI.
4. M. Murdocca and V. Heuring, "Computer Architecture and Organization", 1^{st} Edition, WILEY.
5. Andrew S. Tanenbaum, "Modern Operating Systems", 4^{th} Edition, PHI.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Design and Analysis of Algorithms (PCCS4040T)		
Design and Analysis of Algorithms Laboratory (PCCS4040L)		

Prerequisite: Data Structures, Mathematics.

Course Objective(s):

The objective of the course is to introduce important algorithmic design paradigms and approaches for effective problem solving. To analyze the algorithm for its efficiency to show its effectiveness over the others. In addition, the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems will be introduced.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the performance of algorithms using asymptotic analysis.	L4	Analyze
CO2	Solve the problem using appropriate algorithmic design techniques.	L3	Apply
CO3	Justify the classification of certain problems as NP-Complete.	L5	Evaluate

Design and Analysis of Algorithms (PCCS4040T) Course Contents

Unit-I 04 Hrs.

Analysis of Algorithm: The Efficient Algorithm, Average, Best and Worst Case Analysis, Amortized Analysis, Asymptotic Notations, Analyzing Control Statement, Loop Invariant and the Correctness of the Algorithm.

Unit-II 06 Hrs.

Divide and Conquer Algorithm: Introduction, Recurrence and Different Methods to Solve Recurrence, Substitution and Hash Techniques, Multiplying Large Integers Problem, Problem Solving using Divide and Conquer Algorithm -Max-Min Problem, Large Integer, Matrix Multiplication.

Unit-III 08 Hrs.

Greedy Algorithm: General Characteristics of Greedy Algorithms, Problem Solving using -Activity Selection Problem, Elements of Greedy Strategy, Minimum Spanning Trees (Kruskal's Algorithm, Prim's Algorithm), Graphs: Shortest Paths, The Knapsack Problem, Job Scheduling Problem, Optimal Merge Pattern, Huffman Code, Coin Change Problem.

Unit-IV 10 Hrs

Dynamic Programming: Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating The Binomial Coefficient, Making Coin Change Problem, Assembly Line-Scheduling, Knapsack Problem, Multistage Graphs, All Pairs Shortest Path, Matrix Chain Multiplication, Longest Common Subsequence, Travelling Salesman Problem, OBST, Johnson's Algorithm for Flow Shop Scheduling.

Unit-V 10 Hrs.

Backtracking: Introduction, The Eight Queen's Problem, Sum of Subsets, Hamiltonian Cycle.

Branch and Bound: Introduction, FIFO BB, LIFO BB, LC BB, Fifteen Puzzle Problem, Knapsack Problem, Travelling Salesman Problem, Job Scheduling.

String Matching: Introduction, The Naive String-Matching Algorithm, The Rabin-Karp Algorithm, String Matching with Finite Automata, The Knuth-Morris-Pratt Algorithm.

Unit-VI 04 Hrs.

Introduction to NP-Completeness: The class P and NP, Polynomial Reduction, NP-Comple Problem, NP-Hard Problems. Travelling Salesman Problem, Hamiltonian Problem, Approxin

Algorithms.

Design and Analysis of Algorithms Laboratory (PCCS4040L)

List of Laboratory Experiments

Suggested Experiments:(At least 12 experiments)

1. Implementations of Quick Sort and Merge Sort.
2. Implementations of Knapsack problem.
3. Implementations of Job Sequencing with deadlines.
4. Implementation of Prims's and Kruskal's method.
5. Implementation of Shortest paths algorithms (Dijkstra's algorithm and Bellman-ford algorithm).
6. Implementation of Multistage graphs (Forward and Backward) algorithm.
7. Implementation of Floyd Warshall Algorithm.
8. Implementation of Matrix Chain Multiplication.
9. Implementation of Optimal binary search tree.
10. Implementation of 0/1-Knapsack.
11. Implementation of Travelling salesperson problem.
12. Implementation of Johnson's Algorithm for 2 machines and 3 machines scenarios.
13. Implementation of Longest Common Subsequence (LCS).
14. Implementation of 8 queen problem.
15. Implementation of Sum of subsets.
16. Implementation of 15 puzzle problem.
17. Implementation of Graph coloring.
18. Implementation of Travelling salesperson problem using branch and bound.
19. Implementation of 0/1-Knapsack using branch and bound.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the prac

performed during laboratory sessions.

Text Books:

1. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford Education, 2018.
2. Ellis Horowitz and Sartaj Sahni,"Fundamentals of Computer Algorithms", 2nd Edition, Galgotia, 2012.
3. Steven S Skiena, "The Algorithm Design Manual", Springer International Publications.

Reference Books:

1. Kleinberg and Tardos, "Algorithm Design", 1st Edition, Addison-Wesley, 2006.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms",3rd Edition, The MIT Press, 2009.
3. Aho, Hopcroft, Ullman, "Design and analysis of Algorithm", 1st Edition, Addison-Wesley, 2000.
4. David Harel, "Algorithmics-The spirit of computing", 3rd Edition, Addison-Wesley, 2004.
5. Knuth, "Fundamentals of Algorithms", 3rd Edition, Narosa Publication, 1998.
6. Herbert S. Wilf, "Algorithms and Complexity", 2nd Edition, PHI, 2002.
7. S. E. Goodman and S. T. Hedetniemi, "Introduction to the Design and Analysis of Algorithms", McGraw Hill, 1988.
8. Sara Baase, Allen Van Gelder,"Computer Algorithms Introduction to Design and Analysis", 3rd Edition, Addison- Wesley, 2000.
9. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", 4th Edition, PHI, 2000.
10. Harsh Bhasin, "Algorithms: Design and Analysis", 1st Edition, Oxford, 2015.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Universal Human Values (HMCS4050T)		

Prerequisite: Nil

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the need, relevance, and role of universal human values in personal, academic, and professional life.	L2	Understand
CO2	Demonstrate understanding of self-exploration, harmony in human relationships, and ethical conduct in daily interactions.	L3	Apply
CO3	Apply principles of trust, respect, and responsibility to foster sustainable and compassionate social environments.	L3	Apply
CO4	Analyze the interdependence between individual values, societal well-being, and ecological balance.	L4	Analyze
CO5	Use human values in decision-making processes for holistic development and responsible engineering practice.	L3	Apply

Universal Human Values (HMCS4050T)
Course Contents

Unit-I Introduction: Need, Basic Guidelines, Content and Process for Value Education 05 Hrs.

Purpose and Motivation for the Course. Self-Exploration–What Is It? - Its Content and Process; 'Natural Acceptance' and Experiential Validation- As the Process for Self-Exploration.

Continuous Happiness and Prosperity- A Look at Basic Human Aspirations.

Right Understanding, Relationship and Physical Facility- The Basic Requirements for Fulfilment of Aspirations of Every Human Being with their Correct Priority.

Understanding Happiness and Prosperity Correctly- A Critical Appraisal of the Current Scenario.

Method to Fulfil the Above Human Aspirations: Understanding and Living In Harmony at Various Levels.

Unit-II Understanding Harmony in the Human Being - Harmony in Myself! 06 Hrs.

Understanding Human Being as a Co-Existence of the Sentient 'I' and the Material 'Body'.

Understanding the Needs of Self ('I') and 'Body' - Happiness and Physical Facility.

Understanding the Body as an Instrument of 'I' (I Am Being The Doer, Seer and Enjoyer).

Understanding the Characteristics and Activities of 'I'and Harmony In 'I'.

Understanding the Harmony of I with The Body: Sanyam and Health; Correct Appraisal of Physical Needs, Meaning of Prosperity In Detail.

Programs to Ensure Sanyam and Health.

Unit-III Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship. 06 Hrs.

Understanding Values in Human-Human Relationship; Meaning of Justice (Nine Universal Values in Relationships) and Program for Its Fulfilment to Ensure Mutual Happiness; Trust and Respect as the Foundational Values of Relationship.

Understanding the Meaning of Trust; Difference between Intention and Competence.

Understanding the Meaning of Respect, Difference between Respect and Differentiation; The other Salient Values in Relationship.

Understanding the Harmony in the Society (Society Being an Extension of Family): Resolution, Prosperity, Fearlessness (Trust) and Co-Existence as Comprehensive Human Goals.

Visualizing a Universal Harmonious Order in Society- Undivided Society, Universal Order- From Family to World Family.

Unit-IV Understanding Harmony in the Nature and Existence: Whole existence as Coexistence 05 Hrs.

Understanding the Harmony in the Nature 19. Interconnectedness and Mutual Fulfilment Among the Four Orders of Nature Recyclability and Self-Regulation in Nature.

Understanding Existence as Co-Existence of Mutually Interacting Units in All Pervasive Space. Holistic Perception of Harmony at All Levels of Existence.

Unit-V Implications of the above Holistic Understanding of Harmony on Professional Ethics 06 Hrs.

Natural Acceptance of Human Values 23. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution fnd Humanistic Universal Order. Competence in Professional Ethics:

1. Ability to utilize the professional competence for augmenting universal human order.
2. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems.
3. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case Studies of Typical Holistic Technologies, Management Models and Production Systems. Strategy for Transition from the Present State to Universal Human Order:

1. At the level of individual: As socially and ecologically responsible engineers, technologists, and managers.
2. At the level of society: As mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria ,"Human Values and Professional Ethics", Excel Books, New Delhi, 2010

Reference Books:

1. A Nagaraj, "Jeevan Vidya: EkParichaya" Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, "Human Values," New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi,"The Story of My Experiments with Truth" .
5. E. F Schumacher, "Small is Beautiful".
6. Cecile Andrews, "Slow is Beautiful".

7. J C Kumarappa, “Economy of Permanence”.

8. PanditSunderlal, “Bharat Mein Angreji Raj”.

9. Dharampal, “Rediscovering India”.

10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”.

11. Maulana Abdul Kalam Azad, “India Wins Freedom”.

12. Romain Rolland , “Vivekananda”.

13. Romain Rolland, “Gandhi”.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Web Engineering Laboratory (PCCS4060L)		

Prerequisite: Programming Fundamentals

Course Objective(s):

The objective of this lab is to provide the basic framework of web development (MERN Stack) and cloud computing.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a website as per the requirements.	L6	Create
CO2	Apply the concepts of cloud computing to improve the efficiency of web development.	L3	Apply
CO3	Evaluate the requirement of the problem and select appropriate method of web development.	L5	Evaluate

Web Engineering Laboratory (PCCS4060L)

List of Laboratory Experiments

Suggested Experiments:(Any 10)

- HTML
  - Create a static web page using HTML.
  - Create a class timetable using HTML.
  - Create a registration form using HTML.
  - Create a web page using HTML5 tags.
- CSS
  - Design a web page using External or Embedded Style Sheet.
  - Design a responsive web page using media queries and CSS3.
  - Design a web page using Bootstrap.
  - Design a resume using Bootstrap.
  - Design the admission form using Bootstrap.
- Client-Side Scripting
  - Programs based on objects in JavaScript.
  - Program to design a calculator using JavaScript.
  - Programs based on form validation.
- React JS
  - Create an application using React.
  - Introduction to Git and GitHub
  - Introduction to Version Control
  - Using Git Locally and Remotely
  - Collaboration
- Server-Side Scripting
  - Installation and Configuration of Node.js server
  - Program based on inbuilt functions in Node.js
- Express and MongoDB
  - Using Mongoose to make schemas in MongoDB.

  - Making API end points using Express.
  - Doing CRUD on database MongoDB using Express.
  - Writing tests using mocha and chai.

- XML and XSL
  - Design XML using XML DTD and schema.
  - Implementing XSL elements in XML.
  - Validating XML data through DTD and storing in database.

- Concepts of Cloud Computing
  - Introduction to cloud computing.
  - NIST model
  - Service and Deployment models.

- Networking and Security
  - Identity and Access Management
  - Networking basics
  - VPC networking and security
  - Design a VPC
  - Build your own VPC and Launch a Web Server

- Compute Service
  - Compute Services overview
  - Elastic Computing
  - Serverless Compute service
  - Deploying and scaling web applications

- Storage Service
  - Cloud object storage
  - Cloud block storage
  - Elastic file system

- Database Service
  - Cloud Relational database services
  - Cloud NoSQL Databases

- Elastic load balancing

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Vasan Subramanian,"Pro MERN Stack", 2nd Edition, Apress Publication.
2. Shama Hoque, "Full-Stack React Projects", 2nd Edition, Packt Publication.
3. Rajkumar Buyya, James Broberg, Goscinki,"Cloud Computing: Principles and Paradigms", Wiley.

Reference Books:

1. Benjamin LaGrone, "HTML5 and CSS3 Responsive Web Design Cookbook", 1st Edition, Packt Publishing, 2013.
2. DT Editorial Services, "Web Technologies: Black Book", 1st Edition, Dreamtech Press, 2018.
3. Christopher Schmitt, Kyle Simpson, "HTML5 Cookbook", 1st Edition, O'Reilly Media Inc., 2011.
4. Uttam K. Roy, "Web Technologies", 1st Edition, Oxford University Press, 2010.
5. Greg Sidelnikov, "React. Js Book: Learning React JavaScript Library from Scratch", 1st Edition, Independently Published, 2017.
6. DT Editorial Services, "HTML5 Black Book", 2nd Edition, Dreamtech Press, 2016.
7. Ben Frain, "Responsive Web Design with HTML5 and CSS3", 2nd Edition, Packt Publishing, 2015.
8. Steve Suehring, "JavaScript Step by Step", 3rd Edition, Pearson Education, 2013.
9. Stoyan Stefanov, "React Up Running Building Web Applications", 1st Edition, O'Reilly Media Inc., 2016.
10. Velte, "Cloud Computing a Practical Approach", Tata McGraw-Hill Education.
11. Sandip Bhowmik, "Cloud Computing", Cambridge University Press, 2017.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: IV
Semester Project-II (PJCS4070L)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the departmental committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done (Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 5.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 6.

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Employability Skill Development Program-I (HMCS4080)		

Course Objectives:

1. To enhance the problem solving skills.
2. To improve the basic mathematical skills for solving real life examples.
3. Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
4. Demonstrate an understanding of computer programming language concepts.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic concepts of Quantitative Ability, including profit, loss, time, work, and geometry.	L2	Understand
CO2	Demonstrate the concepts of Quantitative Ability for problem solving.	L3	Apply
CO3	Demonstrate the concept of Variables and Functions through examples.	L3	Apply
CO4	Demonstrate the concept of Multithreading and String Handling.	L3	Apply
CO5	Explain the fundamentals of Object-Oriented Programming.	L2	Understand
CO6	Describe the concepts of Distributed Database.	L2	Understand

Employability Skill Development Program-I (HMCS4080) Course Contents

Unit-I Aptitude 08 Hrs.

Quantitative Aptitude : Algebra, Profit and Loss, Average & Allegation / Mixture, Time and Work, Geometry Mensuration, Numbers , Percentage, Permutation and Combination, Probability, Ratios & Proportion, Time and Distance. Reasoning : Analytical, Puzzles, Blood relationship, Data Interpretation, Data sufficiency

Unit-II Fundamental of Programming 20 Hrs.

Variables: Local variables, Global variables, 'global' keyword, Rules of Identities,

Functions : Introduction, Prototype, Classification of functions, No arguments and No return values, With arguments and With return values.

No arguments and With return values : With arguments and No return values, Recursion, Argument type functions, Default arguments functions, Required arguments functions, Keyword arguments functions, Variable arguments function.

Operators : Arithmetic Operators, Relational operators, Logical operators, Bitwise operators, Shift operators.

Control Statements : Conditional Control Statements, if, if-else, if-elif-else, nested-if, Loop Control Statements, While, For.

Branching Statements: Break, Continue, pass, return, exit.

Exception Handling: Introduction, The need of exception handling, Getting exceptions, Default exception handler, Handling exception, Try, Except, Try with multiple except blocks Handling exceptions using Exception class, Finally, block, Releasing resources using Finally block, Raise, Creating a user exception class., Raise exception manually, Exceptions based application.

Multithreading : Introduction, Multitasking, Multi tasking v/s Multithreading, threading module, Thread class introduction, Creating thread, The life cycle of a thread, Single-threaded application, Multi-threaded application, Sleep() method. Sleep() v/s run(), Join() v/s Sleep(), Multiple custom threads creation, The execution time of single-threaded application, The execution time of multi-threaded application, Synchronization of threads. Inner classes basic syntax of inner class, Advantages of Inner classes, Access class level members of inner classes, Access object level members of inner classes, Local inner classes, Complex inner classes, Accessing data of inner classes.

Regular expressions:'re' module, Match(), Search(), find() etc, and actual projects web scrapping Mail extraction Date extraction, Mobile number extraction, Vehicle number extraction, zoom chat analysis, Expressions using operators and symbols: Split string into characters, Split string into v Lambda expressions.

String handling using regex: Introduction to Strings, Indexing and Slicing, Special operators in String handling, Old style String formatting, String library methods, Quotes and Escape characters in a String representation, String Immutability, Logical programs using Strings.

Object Oriented Programming : Introduction to OOPs, Classes, Objects, Structure to OOP application, Contexts of OOP application, Class level members, Object level members, self variable, Constructor and Initialization of object. Access modifiers : Private, Protected, Public, Program codes. Encapsulation Rules, Implementation, Abstraction, Polymorphism Inheritance Introduction, Types of Inheritance, Single inheritance, Multi-Level inheritance, Method overriding, Object initialization using constructor, Multiple inheritances, Hierarchical inheritance, Method overriding in Multi level inheritance.

Reference Books:

1. Dr. R S Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publication
2. M. G. Venkateshmurthy, "Programming Techniques through C", Pearson Publication.
3. Behrouz Forouzan, "A Computer Science Structure Programming Approaches using C", Cengage Learning.
4. Yashwant Kanetkar, "Let Us C", BPB Publication.

Evaluation Scheme:

Teacher Assessment(TA):

Teacher's Assessment (TA) will carry weightage of 50 marks. The components of TA are

1. MCQ Test based on Aptitude: 20 Marks
2. MCQ Test based on Programming skills: 30 Marks
3. Total Marks: 50 Marks

Semester - III

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Mathematics for Intelligent Systems (BSCS3010T)		

Prerequisite: Concepts of basic matrices, partial derivatives and basic probability.

Course Objective(s):

To build the strong foundation in learners of mathematics needed for building concepts of machine learning.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze probability of random variables and probability distributions.	L4	Analyze
CO2	Use knowledge of linear algebra.	L3	Apply
CO3	Apply concepts of matrix theory.	L3	Apply
CO4	Apply concepts of calculus.	L3	Apply
CO5	Analyze different optimization techniques.	L4	Analyze

Mathematics for Intelligent Systems(BSCS3010T) Course Contents

Unit-I Probability, Random Variables and Probability Distributions 10 Hrs.

Probability: Conditional Probability, Mutually and Pair Wise Independent Events, Bayes' Theorem

Random Variables: Discrete Random Variable, Probability Mass Function, Discrete Distribution Function, Continuous Random Variable, Probability Density Function, Continuous Distribution Function, Mathematical Expectation, Moment Generating Function, Two-Dimensional Random Variable and its Joint Probability Mass and Density Function, Marginal Distribution Function, Conditional Distribution Functions, Covariance, Joint Moments.

Probability Distributions: Discrete Probability Distribution: Binomial Distribution, Poisson Distribution, Hypergeometric Distribution.

Continuous Probability Distribution: Uniform Distribution, Exponential Distribution, Normal Distribution, Beta Distribution, Gamma Distribution, Central Limit Theorem.

Unit-II Linear Algebra 08 Hrs.

Vectors in N-Dimensional Vector Space, Properties, Dot Product, Cross Product, Norm and Distance,Vector Spaces over Real Field, Properties of Vector Spaces over Real Field, Subspaces, Linear Independence and Dependence of Vectors, Span of Vectors, Basis of a Vector Space, Dimension of a Vector Space, Cauchy Schwarz Inequality, Linear Transformation, Norms and Spaces, Orthogonal Compliments and Projection Operator, Kernel Hilbert Spaces.

Unit-III Matrix Theory 08 Hrs.

Characteristic Equation, Eigen Values and Eigen Vectors, Properties of Eigen Values and Eigen Vectors, Cayley-Hamilton Theorem, Examples Based on Verification of Cayley Hamilton Theorem, Similarity of Matrices, Diagonalization of Matrices, Functions of Square Matrix, Derogatory and Non-derogatory Matrices, Least Squared and Minimum Normed Solutions.

Unit-IV Calculus 04 Hrs.

Gradient, Directional Derivatives, Jacobian, Hessian, Convex Sets, Convex Functions and its Properties.

Unit-V Optimization 12 Hrs.

Unconstrained and Constrained Optimization, Convergence.

Unconstrained Optimization Techniques: Newton's Method, Quasi Newton Method.

Constrained Optimization Techniques: Gradient Descent, Stochastic Gradient Descent, Penalty Function Method, Lagrange Multiplier Method, Karush–Kuhn–Tucker Method, Simplex Method, Penalty and Duality, Dual Simplex Method, Downhill Simplex Method.

List of tutorials: (any 8)

1. To solve numerical on discrete probability distributions.
2. To solve numerical on continuous probability distributions.
3. To solve numerical on vector spaces (basis and dimension).
4. To solve numerical on cauchy-schwarz inequality and linear transformation.
5. To solve numerical on diagonalizability using eigenvalues and eigenvectors.
6. To solve numerical on minimal polynomial and functions of a matrix.
7. To solve numerical on calculus.
8. To solve numerical on Gradient descent and Lagrange's multiplier method.
9. To solve numerical on KKT method.
10. To solve numerical on all forms of simplex method.

Any other tutorial based on syllabus may be included which would help the learner to understand topic/concept.

Text Books:

1. Dr. B. S. Grewal, "Higher Engineering Mathematics", 44^{th} Edition, Khanna Publication, 1965.
2. Kanti B. Datta, "Mathematical Methods in Science and Engineering", 1^{st} Edition, Cengage Learning India, 2011.
3. Hamdy A. Taha, "Operations Research - An Introduction", Pearson, 10^{th} Edition, 2010.
4. Kanti Swarup, P. K. Gupta, Mohan Man, "Operations Research", 2020 Edition, S Chand Publication, 2005.

Reference Books:

1. W. Cheney, "Analysis for Applied Mathematics", 1^{st} Edition, New York: Springer Science+Business Media, 2001.
2. S. Axler, "Linear Algebra Done Right", 3^{rd} Edition, Springer International Publishing, 2015.
3. J. Nocedal and S. J. Wright, "Numerical Optimization", 2^{nd} Edition, New York: Sp Science+Business Media, 2006.

4. J. S. Rosenthal, "A First Look at Rigorous Probability Theory", 2^{nd} Edition, Singapore: World Scientific Publishing, 2006.

5. Seymour Lipschutz and Marc Lipson, "Linear Algebra Schaum's outline series", 4^{th} Edition, Mc-Graw Hill Publication, 2009.

6. Erwin Kreysizg, John Wiley & Sons, Inc, "Advanced Engineering Mathematics", 10^{th} Edition, 2000.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Data Structures and Algorithms (PCCS3020T)		
Data Structures and Algorithms Laboratory (PCCS3020L)		

Prerequisite: Computer Programming (C Programming)

Course Objective(s): The course intends to introduce and familiarize students with data structures, their use in solving real time complex problems and implementation of these data structures. The course also aims to provide mathematical approach for analyzing algorithms using asymptotic notation and for measuring efficiency of algorithms. Finally, the course intends to make students learn various sorting and searching techniques and choose efficient one based on their efficiency.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Make use of various operations like searching, insertion, deletion, traversal, etc. on various data structures.	L3	Apply
CO2	Evaluate appropriate (efficient) sorting, searching, and hashing techniques for a given problem and implement them.	L5	Evaluate
CO3	Choose appropriate (efficient) data structures and algorithms to solve specified problems.	L5	Evaluate
CO4	Evaluate and analyze the efficiency of algorithms based on time and space complexity.	L5	Evaluate
CO5	Develop new solutions for given problems or improve existing ones for better efficiency and optimization.	L6	Create

Data Structures and Algorithms (PCCS3020T)
Course Contents

Unit-I Review and Introduction — 06 Hrs.

Review: Pointers, Structures, Function, Recursion.

Introduction to Data Structures: Need of Data Structures, Types of Data Structures, Abstract Data Type (ADT).

Introduction to Algorithms and Analysis: Need of Writing Algorithm, SDLC (System Development Life Cycle) and role of algorithms, Asymptotic Notation (Big-Oh, Big Omega, Theta Notations), Order of Growth Functions, Complexity Analysis Techniques, Few examples of analysis of algorithms (like Fibonacci, prefix average, etc.)

Unit-II Linked Lists — 06 Hrs.

Basic Concept of Linked List, Comparison of Sequential (Array-based) and Linked Organizations, Dynamic Memory Management, ADT of Linked List, Singly Linked List, Doubly Linked List, Circular Linked List, various basic and Advanced Operations on Linked List (Insertion, Deletion, Merge, Traversal, Copy, Reverse etc.) and their Analysis, Applications of Linked Lists.

Unit-III Stack and Queue — 08 Hrs.

Stacks: Introduction to Stack, Stack as an ADT, Stack ADT Implementation using Array and Linked List with respective Analysis and Comparison, Applications of Stacks: Expression Conversion (Infix to Prefix and Postfix) and Evaluation(Postfix Expression Evaluation), Parenthesis Correctness etc.

Queues: Introduction to Queue, Queue as an ADT, Queue ADT Implementation using Array and Linked List with respective Analysis and Comparison, Linear Queue, Circular Queue, Priority Queue: Heap based Implementation, Deques, Applications of Queues.

Unit-IV Trees — 08 Hrs.

Introduction to Trees, Basic Terminology, Types of Trees, Binary Tree Representation, Traversal of Binary Tree, Expression Tree, Binary Search Tree, Operations on Binary Search Tree and their Analysis, AVL Tree, Applications of Trees.

Unit-V Graphs — 06 Hrs.

Representation of Graph, Types of Graph, Breadth-First Search (BFS), Depth–First Search (DFS), Minimum Spanning Tree: Prim's & Kruskal's Algorithm, Applications of Graphs.

Unit-VI Sorting and Searching Techniques — 08 H

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Radix

Analysis of Sorting Techniques.

Searching: Linear Search, Binary Search, Hashing Techniques and Collision Resolution Techniques, Linear Hashing, Hashing with Chaining, Separate Chaining, Open Addressing, Rehashing, Analysis of Searching Techniques.

Data Structures and Algorithms Laboratory (PCCS3020L)

List of Laboratory Experiments

Suggested Experiments:

1. Recursion
    - Implementation of Recursive Algorithms to Solve Various Fundamental Problems like: Addition of elements in an Array, Reversing an Array, Adding all digits of a given Numeral, Prefix Average, Factorial of a given number, Fibonacci Sequence etc.
2. Sorting and Searching
    - Implementation of Insertion Sort, Selection Sort Menu Driven Program.
    - Implementation of Quick Sort.
    - Implementation of Merge Sort.
    - Implementation of Heap Sort.
    - Implementation of Binary Search.
    - Implementation of Hashing Functions with Different Collision Resolution Techniques.
3. Linked List
    - Implementation of Linked Lists Menu Driven Program.
    - Implementation of different operations on Linked List: Copy, Concatenate, Split, Reverse, Count number of Nodes etc.
    - Implementation of Polynomial Operations (Addition, Subtraction) using Linked List.
4. Stack and Queue
    - Implementation of Infix to Postfix Transformation and its Evaluation Program.
    - Implementation of Infix to Prefix Transformation and its Evaluation Program.
    - Implementation of Double Ended Queue Menu Driven Program.
    - Implementation of Queue Menu Driven Program.
    - Implementation of Circular Queue Menu Driven Program.
    - Implementation of Priority Queue Program using Array.
    - Implementations of Linked Lists Menu Driven Program (Stack and Queue).

- Implementations of Double Ended Queue using Linked Lists.
- Implementation of Priority Queue program using Heap.

5. Trees

   - Implementation of BT (Binary Tree) Program.
   - Implementation of BST Program.
   - Implementation of Various Operations on Tree like: Copying Tree, Mirroring a Tree, Counting the Number of Nodes in the Tree, Counting only Leaf Nodes in the Tree.
   - Implementation of Construction of Expression Tree using Postfix Expression.

6. Graphs

   - Implementation of Graph Menu Driven Program (DFS & BFS).

Note: Students are required to complete 12 experiments. At least one experiment is mandatory from each topic. Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. R. F. Gilberg and B. A. Forouzan, "Data Structures – A Pseudocode Approach with C ", 2^{nd} Edition,Cengage Learning, 2005.
2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2^{nd} Edition, W. H. Freeman and Company, 2008.

Reference Books:

1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C ", 4^{th} Edition, Pearson, 2014.
2. M. T. Goodrich, R. Tamassia, D. Mount, "Data Structures and Algorithms in C++ ", Wiley, 2004.
3. Tenenbaum, Langsam, Augenstein, "Data Structures using C ", Pearson, 2004.
4. Aho, Hopcroft, Ullman, "Data Structures and Algorithms", Addison-Wesley, 2010.
5. Reema Thareja, "Data Structures using C ", Oxford, 2017.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Foundations of Data Analysis (PCCS3030T)		
Foundations of Data Analysis Laboratory (PCCS3030L)		

Prerequisite: Basic Mathematics

Course Objective(s): To develop skills of data analysis techniques for data modelling.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use visualization techniques to understand data.	L3	Apply
CO2	Use ETL and perform OLAP operations.	L3	Apply
CO3	Analyze various techniques to improve quality of data.	L4	Analyze
CO4	Apply appropriate feature engineering techniques to prepare data for modelling.	L3	Apply
CO5	Use sampling techniques to sample data for modelling.	L3	Apply

Foundations of Data Analysis (PCCS3030T)
Course Contents

Unit-I Data — 06 Hrs.

Data Objects and Attributes: Nominal, Binary, Ordinal, Numeric, Discrete, Continuous. Characteristics of Data Sets: Dimensionality, Sparsity, Resolution. Types of Data Sets: Record Data, Data Matrix, Graph-based Data, Sequential Data, Sequence Data, Time Series Data, Spatial Data.

Data visualization: Temporal: Scatter Plots, Time Series Sequences, Line Graphs; Hierarchical: Tree Diagrams, Ring Charts; Network: Matrix Charts, Node-link Diagrams, Word Clouds, Alluvial Diagrams; Multidimensional: Pie Chart, Venn Diagrams, Stacked Bar Graph, Histograms; Geospatial: Flow Map, Density Map, Heat Maps.

Unit-II ETL Process and OLAP — 08 Hrs.

Major steps in ETL Process, Data Extraction: Techniques, Data Transformation: Basic Tasks, Major transformation types, Data Loading: Applying Data, OLTP Vs OLAP, OLAP definition, Dimensional Analysis, Hypercubes.

OLAP Operations: Drill down, Roll up, Slice, Dice and Rotation, OLAP models: MOLAP, ROLAP.

Unit-III Data Preprocessing — 10 Hrs.

Data Quality: Measurement Error, Data Collection Error, Noise, Artifacts, Precision, Bias, Accuracy, Outliers, Missing Values, Inconsistent Values, Duplicate Values.

Data Cleaning: Handling Missing Values and Noisy Data.

Data Transformation: Smoothing, Attribute Construction, Aggregation, Normalization.

Data Discretization: Binning, Histogram analysis, Clustering.

textbfOutlier Detection: Types of Outliers, Challenges, Statistical Method, Proximity-based Method, Clustering-based Method.

Unit-IV Feature Engineering — 10 Hrs

Curse of Dimensionality, **Feature Selection**: Univariate methods (Pearson Correlation, F-Score, Chi-Square, Signal to Noise Ratio) and Multivariate methods (Forward Selection, Backward Selection and Stepwise Selection), **Feature Extraction**: Principal Component Analysis.

Unit-V Elementary Sampling Theory — 08 Hrs.

Census and Sampling Survey, Steps in Sampling Design, Criteria of selecting a good sample procedure, Characteristics of a good Sample design, Types of sample design: Non Probability and Probability Sampling, Complex Random Sampling Design: Symmetric Sampling, Stratified Sampling, C Sampling, Area Sampling, Sequential Sampling and Multi-stage Sampling.

Foundations of Data Analysis Laboratory (PCCS3030L)

List of Laboratory Experiments

Suggested Experiments:(At least 8 experiments)

Visualization experiments can be performed using Tableau and Data Preprocessing experiments can be performed using Python/R.

1. Create new measures on a given dataset and visualize them using a bar graph.
2. Perform time series aggregation, apply filters on a given dataset, create line and area charts.
3. Apply maps, scatter plots on a given dataset and create a dashboard.
4. Perform joins, blends and create dual axis chart.
5. Perform table calculations, bins, distributions and create Heat maps.
6. Create an interactive data story.
7. Perform Exploratory Data Analysis on a given dataset.
8. Perform Data cleaning on a given dataset.
9. Perform necessary Data Transformation on a given dataset.
10. Perform correlation analysis on a given dataset.
11. Perform dimensionality reduction using PCA.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Jason Browniee, "Data Preparation for Machine Learning", Machine Learning Mastery.
2. Jason Osborne, "Best Practices in Data Cleaning: A Complete Guide to Everything you Need to Do Before and After Collecting Your Data", Sage Publication, 2012.
3. Q. Ethan McCallum, "Bad Data Handbook", O'Reilly, 2012.
4. Max Kuhn and Kjell Johnson, "Feature Engineering and Selection: A Practical Approach for Predictive Models", CRC Press, 2020.

Reference Books:

1. Jeffrey Shaffer, Steve Wexler, Andy Cotgreave, "The Big Book of Dashboards: Visualizing your Data using Real-World Business Scenarios", Wiley 2017.

2. C. R. Kothari, "Research Methodology-Methods and Techniques", 2^{nd} Edition, New Age International.

3. S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", 12^{th} Edition, Sultan Chand Publisher.

4. Paulraj Ponniah, "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals", 2^{nd} Edition, Wiley.

5. Rayan Sleeper, "Practical Tableau", O'Reilly 2018.

6. Han, Kamber, Morgan Kaufmann, "Data Mining Concepts and Techniques", 3^{rd} Edition.

7. Wes McKinney, "Python for Data Analysis", 2^{nd} Edition, O'Reilly, 2018.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Database Management Systems (PCCS3040T)		
Database Management Systems Laboratory (PCCS3040L)		

Course Objective(s): The course intends to introduce the students to the management of database systems, with an emphasis on how to design, organize, maintain and retrieve information efficiently and effectively from a database.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Design an optimized database.	L6	Create
CO2	Create and populate a relational database and retrieve information from the database by formulating SQL queries.	L6	Create
CO3	Explain the concepts of transaction, concurrency and recovery.	L2	Understand
CO4	Apply indexing mechanisms for efficient retrieval of information from database.	L3	Apply

Database Management Systems (PCCS3040T)
Course Contents

Unit-I Introduction to Database Concepts — 03 Hrs.

Introduction, Characteristics of Databases, File System v/s Database System, Users of Database System, Data Independence, DBMS System Architecture, Database Administrator.

Unit-II Entity–Relationship Data Model — 08 Hrs.

The Entity-Relationship (ER) Model: Entity Types: Weak and Strong Entity Sets, Entity Sets, Types of Attributes, Keys, Relationship Constraints: Cardinality and Participation.

Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.

Unit-III Relational Model and Relational Algebra — 08 Hrs.

Introduction to the Relational Model, Relational Schema and Concept of Keys, Mapping the ER and EER Model to the Relational Model.

Relational Algebra: Unary and Set Operations, Relational Algebra Queries.

Unit-IV Structured Query Language (SQL) — 09 Hrs.

Overview of SQL, Data Definition Commands, Data Manipulation Commands, Data Control Commands, Transaction Control Commands.

Integrity Constraints: Key Constraints, Domain Constraints, Referential Integrity, Check Constraints, Set and String Operations, Aggregate Function, Group By Clause, Having Clause.

Views in SQL, Joins, Nested and Complex Queries.

Unit-V Relational Database Design — 10 Hrs.

Pitfalls in Relational-Database Designs, Concept of Normalization, Functional Dependencies, First Normal Form, 2NF, 3NF, BCNF.

Transactions Management and Concurrency:

Transaction Concept, Transaction States, ACID Properties, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-Based, Timestamp-Based Protocols.

Recovery System: Introduction to Recovery System.

Unit-VI Indexing Mechanism — 04 Hrs.

Hashing Techniques, Types of Indexes: Single Level Ordered Indexes, Multilevel Indexes,Overview of BTrees and B+ Trees.

Database Management Systems Laboratory (PCCS3040L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. To draw an ER diagram for a problem statement.
2. To implement Basic SQL commands.
3. To access & modify data using SQL.
4. To implement Joins and Views.
5. To implement Subqueries.
6. To implement Integrity Constraints.
7. To implement triggers.
8. To implement procedures, functions and cursors.
9. To simulate ARIES recovery algorithm.
10. To demonstrate export-import commands.
11. To implement B-trees/B+ trees.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Korth, Silberchatz, Sudarshan, "Database System Concepts", 6^{th} Edition, McGraw – Hill.
2. Elmasri and Navathe, "Fundamentals of Database Systems", 5^{th} Edition, Pearson Education.
3. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", 5^{th} Edition, Thomson Learning.
4. Chhanda Ray, "Distributed Database System", Pearson Education India.
5. G. K. Gupta, "Database Management Systems", McGraw – Hill.

Reference Books:

1. Dr. P.S. Deshpande, "SQL and PL/SQL for Oracle 10g, Black Book", Dreamtech Press.
2. Gillenson, Paulraj Ponniah, "Introduction to Database Management", Wiley Publication

3. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw – Hill.

4. M. Tamer Ozsu, Patrick Valduriez, "Principles of Distributed Database", 2nd Edition, Pearson Education India.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Statistics for Data Science (PCCS3050T)		
Statistics for Data Science Laboratory (PCCS3050L)		

Prerequisite: Probability, Probability distribution

Course Objective(s): To build the strong foundation in statistics which can be applied to analyze data and make predictions.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Interpret data using descriptive statistics.	L2	Understand
CO2	Use sampling distributions and estimate statistical parameters.	L3	Apply
CO3	Formulate hypothesis based on data and perform testing using various statistical techniques.	L6	Create
CO4	Develop analysis of variance on data.	L3	Apply
CO5	Examine relations between data.	L3	Apply

Statistics for Data Science (PCCS3050T)
Course Contents

Unit-I Introduction to Statistics 08 Hrs.

Types of Statistics, Population vs Sample

Measures of Central Tendency: Arithmetic Mean, Properties, Weighted Mean, Properties, Median, Mode, Grouped and Ungrouped Data, Empirical Relation between the Mean, Median and Mode, Geometric Mean, Harmonic Mean, Relation between Arithmetic, Geometric and Harmonic Mean, Outlier.

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Properties, Variance, Root Mean Square Deviation, Empirical Relations between Measures of Dispersion, Absolute and Relative Dispersion, Coefficient of Variation, Moments, Pearson's β and γ Coefficients, Skewness, Kurtosis, Population Parameters and Sample Statistics, Histogram, Frequency Polygon.

Measures of Position: Quartiles, Interquartile Range, Semi Interquartile Range, Percentiles, Percentile Rank, 10–90 Percentile Range, Box and Whisker Plot.

Unit-II Sampling Distribution and Estimation 07 Hrs.

Sampling Distribution: Central Limit Theorem, Population Distribution, Chi-Square Distribution, z-Distribution, Student's t-Distribution, f-Distribution.

Statistical Estimation: Characteristics of Estimators, Consistency, Unbiasedness, Unbiased Estimates, Efficient Estimates, Sufficient Estimators, Point Estimates, Interval Estimates, Determination of Sample Size for Estimating Mean and Proportions, Estimates of Population Parameters, Probable Error.

Unit-III Hypothesis Testing for Data Driven Decision Making 12 Hrs.

Hypothesis testing: Test of Significance, Null and Alternative Hypothesis, Type I and Type II Error, Factors Affecting Type II Error, Probability of Type II Error, Power of Test, p Value, Critical Region, Level of Significance.

Confidence Interval: Population Mean, Difference between Two Population Means, Population Proportion, Difference between Two Population Proportions, Variance, Ratio of Variances of Two Populations. Goodness of Fit Test using Kolmogorov-Smirnov Test and Anderson Darling Test.

Tests using z-Statistics: Difference between Sample Proportion and Population Proportion, Difference between Two Sample Proportion, Difference between Sample Mean and Population Mean with Known σ and Unknown σ, Difference between Two Sample Means, One Tailed and Two Tailed Tests.

Test using t-Statistics: Difference between Sample Mean and Population Mean, Difference between Two Independent Sample Means, Difference between Means from the Same Group.

Test using f-Statistics: Equality of Population Variance.

Test using Chi-Square Statistics: Test of Independence, Goodness of Fit.

Unit-IV Analysis of Variance (ANOVA) for data analysis 07 Hrs.

Sample Size Calculation, One Way ANOVA, POST-HOC Analysis (Tukey's Test), Randomized Block Design, Two Way ANOVA.

Unit-V Examining Relationship 08 Hrs.

Correlation: Scatter Plot, Covariance, Karl Pearson's Coefficient of Correlation, Hypothesis Test for Correlation, Correlation vs Causation, Extreme Data Values, Limits of Correlation Coefficient, Rank Correlation, Spearman's Rank Correlation Coefficient, Repeated Ranks, Partial and Multi Correlation.

Regression: Linear Regression Analysis, Lines of Regression, Regression Coefficients, Scatter Plot with Regression Lines, Hypothesis Test for Regression, Multiple Regression, Coefficient of Determination, Residuals, Collinearity, Influential Observations.

Statistics for Data Science Laboratory (PCCS3050L)

List of Laboratory Experiments

Suggested Experiments:(any 8 using Python)

1. To perform descriptive statistics on data.
2. To visualize descriptive statistics on data.
3. To prove central limit theorem.
4. To study sampling distributions and their parameters.
5. To perform statistical estimation tests on data.
6. To calculate confidence interval for different parameters.
7. To perform goodness of fit using Kolmogorov-Smirnov test and Anderson Darling test.
8. To perform hypothesis test using z statistics.
9. To perform hypothesis test using t statistics.
10. To perform hypothesis test using f statistics.
11. To perform hypothesis test using Chi Square.
12. To perform ANOVA on given data.
13. To perform Correlation on given data.

14. To perform Regression on given data Regression and evaluate the model.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Thomas Haslwanter, "An Introduction to Statistics with Python", 3^{rd} Edition, Springer, 2016.
2. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", 1^{st} Edition, Green Tea Press, 2011.
3. Enrich L. Lehmann, Joseph P. Romano, "Testing Statistical Hypotheses", 3^{rd} Edition, Springer, 2008.
4. S. P. Gupta, "Statistical Methods", 43^{rd} Edition, Sultan Chand, 2014.

Reference Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, "Practical Statistics for data scientists 50+ Essential Concepts Using R and Python", 2^{nd} Edition, O'Reilly Media, Inc, 2020.
2. David Freedman, Robert Pisani, Roger Purves, W. W. Norton, "Statistics", 4^{th} Edition, 2007.
3. S. C. Gupta, V. K. Kapoor, "Fundamentals of mathematical statistics", 10^{th} Edition, Sultan Chand, 2002.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Programming with Python Laboratory (PCCS3060L)		

Prerequisite: Programming Fundamentals

Course Objective(s):

1. To learn the basic and OOP concepts of Python.
2. To study various advance python concept like inheritance, exception handling, modules etc.
3. To learn to develop GUI based standalone and web application.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Use basic data types and data structures in Python.	L3	Apply
CO2	Demonstrate the concepts of Object-Oriented Programming.	L3	Apply
CO3	Experiment with file and directory handling, and text processing concepts in Python.	L3	Apply
CO4	Make use of database connectivity and client-server communication using Python.	L3	Apply
CO5	Utilize various advanced modules of Python for data analysis.	L3	Apply

Programming with Python Laboratory (PCCS3060L) Course Contents

Unit-I Python Basics 08 Hrs.

Data Types in Python, Operators in Python, Input and Output, Control Statement, Arrays in Python, String and Character in Python, Functions, List and Tuples, Dictionaries.

Unit-II Introduction to OOP 08 Hrs.

Classes, Objects, Constructor, Methods, Abstraction, Inheritance, Magic Methods, Exception Handling

Unit-III Advanced Python 09 Hrs.

Building Modules, Packages: Python Collections Module, Opening and Reading Files and Folders (Python OS Module, Python Datetime Module, Python Math and Random Modules, Text Processing and Regular expression in Python)

Unit-IV Python Integration Primer 08 Hrs.

Graphical User Interface using Tkinter: Form Designing Networking in Python: Client Server Socket Programming, Python Database Connectivity using SQL lite.

Unit-V Python Advance Modules 09 Hrs.

Numpy: Working with Numpy, Constructing Numpy Arrays, Printing Arrays, Arithmetic Operations on Matrix's, Numpy zeros(), Matplotlib: Matplotlib-Installation and Sample Code, Bar Chart Pandas: Data Processing, Pandas-Data structure, Pandas-Series Data, Data Frames

Programming with Python Laboratory (PCCS3060L)

List of Laboratory Experiments

Suggested Experiments:(Any 10)

1. Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2. Demonstrate the concept of Abstraction in Python.
3. Demonstrate the concept of Inheritance.
4. Demonstrate exception handling.
5. Python program to explore different types of Modules

6. Exploring Files and directories -
   (a) Python program to append data to existing file and then display the entire file.
   (b) Python program to count number of lines, words and characters in a file.
   (c) Python program to display file available in current directory
7. Make use of RE module to do text processing.
8. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
9. Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/ MySQL)using python.
10. Creation of simple socket for basic information exchange between server and client.
11. Make use of advance modules of Python like Matplotlib, Numpy, Pandas.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. "Learn Python the Hard Way", Zed Shaw's Hard Way Series, 3rd Edition,2013.
2. "Python Projects", Laura Cassell, Alan Gauld, wrox publication,2015.

Digital Resources:

1. The Python Tutorial, http://docs.python.org/release/3.0.1/tutorial/
2. http://spoken-tutorial.org
3. www.staredusolutions.org

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: III
Semester Project-I (PJCS3070L)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the department committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done (Log Book Format will be as per Table 1).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 2.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 3.

Table 1: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 2: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 3: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: III
Constitution of India (MCCS3080T)		

Course Objective(s):

1. To provide basic information about Indian Constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the historical background, philosophy, and salient features of the Indian Constitution.	L2	Understand
CO2	Interpret the fundamental rights, duties, and directive principles enshrined in the Constitution for responsible citizenship.	L2	Understand
CO3	Describe the structure, roles, and functions of the legislative, executive, and judiciary branches of government.	L2	Understand
CO4	Analyze the federal structure, center-state relations, and constitutional provisions for governance and emergency powers.	L4	Analyze
CO5	Apply constitutional principles to contemporary socio-political and legal issues, fostering ethical and democratic values.	L3	Apply

Constitution of India (MCCS3080T)
Course Contents

Unit-I Introduction to the Constitution of India — 2 Hrs.

The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.

Unit-II Directive Principles of State Policy — 3 Hrs.

Relevance of Directive Principles State Policy Fundamental Duties.

Union Executives – President, Prime Minister Parliament Supreme Court of India.

Unit-III State Executives — 3 Hrs.

Governor, Chief Minister, State Legislature High Court of State.

Electoral Process in India, Amendment Procedures, 42^{nd}, 44^{th}, 74^{th}, 76^{th}, 86^{th} & 91^{st} Amendments.

Unit-IV Special Provisions — 3 Hrs.

For SC & ST Special Provision for Women, Children & Backward Classes, Emergency Provisions.

Human Rights:

Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Cooperative Societies.

Unit-V Scope & Aims of Engineering Ethics — 3 Hrs.

Responsibility of Engineers, Impediments to Responsibility.

Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.

Text Books:

1. Durga Das Basu, "Introduction to the Constitution on India", Student Edition, Prentice –Hall EEE, 19^{th}/ 20^{th} Edition, 2001.
2. Charles E. Haries, Michael S Pritchard and Michael J. Robins, "Engineering Ethics", Thompson Asia, 2003.

Reference Books:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of Pvt. Ltd. New Delhi, 2004.

3. Brij Kishore Sharma, " Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.

4. Latest Publications of Indian Institute of Human Rights, New Delhi.

Web Resources

1. www.nptel.ac.in
2. www.hnlu.ac.in
3. www.nspe.org
4. www.preservearticles.com

Evaluation Scheme:

1. Student should submit a report on the case study declared by teacher.
2. Audit point shall be awarded subject to submission of report of the case study declared by teacher.

Semester - IV

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Programming Language Principles (PCCS4010T)		
Programming Language Principles Laboratory (PCCS4010L)		

Prerequisite: Computer Basics

Course Objective(s):

To introduce various programming paradigms and basic constructs of programming languages with the concepts of syntax and semantics.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Compare different programming paradigms with their design issues.	L5	Evaluate
CO2	Apply client and server-side scripting to develop applications.	L3	Apply
CO3	Illustrate system programming concepts.	L3	Apply

Programming Language Principles (PCCS4010T) Course Contents

Unit-I Introduction 04 Hrs.

Role of Programming Languages, Need to Study Programming Languages, Characteristics of Programming Languages, Programming Language Paradigms: Imperative, Object Oriented, Functional, Logic, Event Driven and Concurrent Programming, Language Design Issues, Language Translation Issues. Data Types: Properties of Types and Objects, Elementary Data Types, Structured Data Types, Type Conversion, Binding and Binding Times.

Unit-II Imperative Programming Paradigm 08 Hrs.

Procedural Programming: Sequence Control: Implicit and Explicit Sequence Control, Sequencing with Arithmetic Expressions, Sequencing with Non arithmetic Expressions, Sequence Control between Statements. Subprogram Control: Subprogram Sequence Control, Attributes of Data Control, Shared Data in Subprograms, Different Parameter Passing Methods, Lifetime of Variables, Storage Management, Exceptions and Exception Handling. Desirable and Undesirable Characteristics of Procedural Programming. Case Study of C.

Object – Oriented Programming: General Characteristics for Object-Based Programming, Design Principles for Object-Oriented Programming, Implementing Object-Oriented Programming, Desirable Characteristics of Object-Oriented Programming. Object Oriented Programming in Java: Abstraction, Inheritance, Polymorphism, I/O, Access Specification, Interfaces, Packages, Exception Handling, Multithreading, Event Handling. AWT: Working with Windows, Graphics, Text, using AWT Controls, Layout Manager and Menus. Comparative Study of Java and Python.

Unit-III Declarative Programming 08 Hrs.

Logic Programming Language Model, Logical Statements, Resolution, Unification, Search Structures, Applications of Logic Programming. Case Study of Prolog. Applicative Programming Paradigm: Lambda Calculus: Ambiguity, Free and Bound Identifiers, Reductions, Typed Lambda Calculus, Principles of Functional Programming. Case Study of Haskell.

Unit-IV Overview of Scripting Language 04 Hrs

Common Characteristics, Different Problem Domains for using Scripting, Use of Scripting in Web Development-Server and Client-Side Scripting. Innovative Features of Scripting Languages-Names and Scopes, String and Pattern Manipulating, Data Types, Object Orientation.

Unit-V Syntax and Semantics 12 H

Lexical Structure of Programming Languages, Context-Free Grammars and Bnfs, Parse Trees and Abstract Syntax Trees, Ambiguity, Associativity and Precedence, Ebnfs and Syntax Diagrams, Parsing Techniques and Tools, Lexics Vs Syntax Vs Semantics. Attributes, Binding and Semantic Functions, Declarations, Blocks and Scopes, The Symbol Table, Name Resolution and Overloading, Allocation Lifetime and The Environment, Variable and Constants, Aliases, Dangling References and Garbage.

Unit-VI Parallel Programming Paradigm 06 Hrs.

Principles of Parallel Programming, Precedence Graph, Data Parallelism, Control Parallelism, Message Passing, Shared Address Space, Synchronization Mechanisms, Mapping, Granularity.

Programming Language Principles Laboratory (PCCS4010L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. Procedural Programming
    - Write a C program to find whether a triangle can be formed or not. If not display "This Triangle is NOT possible." If the triangle can be formed, then check whether the triangle formed is equilateral, isosceles, scalene or a right-angled triangle. (If it is a right-angled triangle then only print Right-angle triangle do not print it as Scalene Triangle or Isosceles triangle).
    - Write a C program to sort a given 1D array using pointer in ascending order.
2. Object Oriented Programming
    - Implement an application of Encapsulation.
    - Implement an application for different types of Inheritance.
3. Logic Programming: Implement following using PROLOG
    - Write facts for the given statement.
    - Write a program to study rule.
    - Create a family tree.
4. Functional Programming: Implement following using Haskell
    - Write a function to determine the length of a list.
    - Write a function to determine if a given item appears in a list.
    - Write a function to find addition of two number.

- Write a program to find the second lowest grade of any student(s) from the given names and grades of each student using lists and lambda. Input number of students, names and grades of each student.

5. Scripting
   - Implement string and pattern matching using python/PERL.
   - Design Student Registration form using Java Script/PHP.
6. Syntax and Semantics
   - Case study on LEX and YACC Programming.
   - Write a program to identify Tokens.
   - Implement Symbol Table.
7. Parallel Programming
   - Implement inter process communication using RPC.
   - Implement inter process communication using Sockets.
   - Program on multithreading.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept. At least one program per unit should be covered in the laboratory.
Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Roosta Seyed, "Foundations of Programming Languages Design and Implementation", 3rd Edition, Cenage learning.
2. T. W. Pratt, Zelkowitz, "Programming Languages: Design and Implementation", 3rd Edition, PHI, 2002,ISBN-81-203-1038-1.
3. M. Scott, "Programming Language Pragmatics", Morgan Kaufmann Publishers.

Reference Books:

1. R. W. Sebesta, "Concepts of programming languages", 4th Edition, Pearson Education 2001.
2. Sethi Ravi, "Programming Languages: Concepts and Constructs" Pearson Education.
3. Herbert Schildt, "The Complete Reference C", 4th Edition, Tata McGraw Hill.
4. Herbert Schildt, "The Complete Reference Java2", 5th Edition, Tata McGraw Hill.

5. Graham Hutton, "Programming in Haskell", 2^{nd} Edition, Cambridge University Press.

6. John Bloomer, "Power Programming with RPC", O'Reilly.

7. Max Bramer, "Logic Programming with Prolog", Springer

8. M. Lutz, "Learning Python: Powerful Object- Oriented Programming", 5^{th} Edition, O'Reilly.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Machine Learning - I (PCCS4020T)		
Machine Learning – I Laboratory (PCCS4020L)		

Prerequisite: Data Structures, Basic Probability and Statistics

Course Objective(s):

- To introduce the basic concepts and techniques of Machine Learning with designing steps of Machine Learning applications.
- To become familiar with regression, classification and clustering techniques.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain Machine Learning with steps involved in developing machine learning models.	L2	Understand
CO2	Categorize different regression techniques.	L4	Analyze
CO3	Analyze decision tree learning algorithms.	L4	Analyze
CO4	Evaluate Bayesian learning methods.	L5	Evaluate
CO5	Demonstrate Support Vector Machine algorithm.	L3	Apply
CO6	Summarize different clustering techniques.	L2	Understand

Machine Learning - I (PCCS4020T)
Course Contents

Unit-I Introduction to Machine Learning 06 Hrs.

Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps Involved in Developing a Machine Learning Application, Hypothesis and Inductive Bias.

Unit-II Regression 08 Hrs.

Linear Regression, Least Minimum Slope (LMS) Algorithm, Gradient Descent, Lasso and Ridge Regression, Polynomial Regression, Logistic Regression, Maximum Likelihood Function.

Unit-III Trees 08 Hrs.

Introduction to Decision Tree, Learning Decision Tree using ID3 and Gini Index; CART, Overfitting. Ensemble Methods: Bagging (Random Forest) and Boosting (XG Boost).

Unit-IV Classification 06 Hrs

Bayesian Learning, Naive Bayes, Bayesian Network: Representation in Bayesian Belief Network, Inference in Bayesian Network, Applications of Bayesian Network.

Unit-V Introduction to Support Vector Machine 06 Hrs.

Support Vectors, Functional Margin, Geometric Margin, Optimization Problem, Lagrange Duality, KKT Condition, Maximum Margin with Noise, Non-Linear SVM and Kernel Function.

Unit-VI Clustering 08 Hrs.

K-Means, Adaptive Hierarchal Clustering, Gaussian Mixture Models, Expectation Maximization.

Machine Learning – I Laboratory (PCCS4020L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

Students should be encouraged to write these programs from scratch to develop better understanding of the algorithms. Last 30 minutes of the laboratory should be utilized as a discussion on available python libraries and hyperparameters.

1. Perform Linear Regression.
2. Perform Logistic Regression.

3. Perform Decision Tree using GINI.
4. Perform CART decision tree algorithm.
5. Perform Ensemble methods.
6. Perform Bayesian Classification.
7. Perform Support Vector Machine.
8. Perform K-means clustering.
9. Perform Expectation -Maximization.
10. Mini project based on any machine learning application.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill.
2. Peter Harrington, "Machine Learning In Action", DreamTech Press.
3. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press.

Reference Books:

1. Han Kamber, "Data Mining Concepts and Techniques", Morgann Kaufmann Publishers.
2. Stephen Marsland, "Machine Learning An Algorithmic Perspective", CRC Press.
3. Kevin P. Murphy , "Machine Learning — A Probabilistic Perspective".
4. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'reilly.

Weblinks:

1. Towards Data Science: https://towardsdatascience.com
2. Machine Learning — Andrew Ng,Stanford University: https://youtube.com/playlist?list =PLLssT5z_DsKh9vYZkQkYNWcItqhlRJLN
3. Commonly used Machine Learning Algorithms: https://www.analyticsvidhya.com/blog/2017/09/common-machine-learning-algorithms/
4. A Tour to Machine Learning Algorithms: https://machinelearningmastery.com/a-tour-of-machinelearning-algorithms/

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
System Fundamentals (PCCS4030T)		
System Fundamentals Laboratory (PCCS4030L)		

Prerequisite: Basic Mathematics

Course Objective(s):

The objective of this course is to understand the structure, functions and characteristics of computer system and operating systems.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Describe the fundamental organization of a computer system.	L2	Understand
CO2	Solve problems using appropriate memory mapping, process scheduling, and disk scheduling methods.	L3	Apply
CO3	Identify the need of concurrency and apply appropriate method to solve the concurrency or deadlock problem.	L3	Apply
CO4	Differentiate between various processor architectures.	L2	Understand

System Fundamentals (PCCS4030T)
Course Contents

Unit-I 08 Hrs.

Introduction to System Fundamentals: Von Neumann Model, Fixed Point Representation, Register Transfer and Micro-Operations: Floating Point Representation, Arithmetic Micro-Operations, Arithmetic Logical Shift Unit. Addition and Subtraction, Multiplication Algorithms (Booth Multiplication Algorithm), Division Algorithms, Floating Point Arithmetic Operations.

Operating System Architecture: Basic Functions and Services, System Calls, Types of Operating Systems: Batch, Multiprogramming, Multitasking, Time Sharing, Parallel, Distributed & Real -Time O.S., Case Study On Linux OS.

Unit-II 06 Hrs.

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Format, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC).

Process Management: Process Concept, Process States, Process Control, Threads, Uni-Processor Scheduling: Types of Scheduling: Pre-Emptive, Non Pre-Emptive, Scheduling Algorithms: FCFS, SJF, RR, Priority.

Unit-III 08 Hrs.

Memory Organization: Memory Hierarchy, Main Memory, Cache Memory, Memory Mapping, Cache Coherence, Pentium IV Cache Organization, ARM Cache Organization.

Memory Management: Memory Partitioning: Fixed and Variable Partitioning, Memory Allocation: Allocation Strategies (First Fit, Best Fit and Worst Fit), Fragmentation, Swapping, Virtual Memory, Paging, Segmentation, Demand Paging and Page Replacement Policies.

Unit-IV 10 Hrs

Concurrency control:

Concurrency: Principles of Concurrency, Mutual Exclusion: S/W approaches, H/W Support, Semaphores, Monitors, Classical Problems of Synchronization: Readers-Writers and Producer-Consumer Problems and Solutions.

Deadlock: Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher Problem.

Unit-V 04 H

File and I/O Management: File Access Methods, I/O Devices, Organization of I/O Func

Operating System Design Issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, C-SCAN, SSTF), RAID, Disk Cache.

Unit-VI 06 Hrs.

Advance Computer Architecture: Characteristics of Multiprocessors, Flynn's Taxonomy, Parallel Processing Architectures and Challenges, Hardware Multithreading, Multicore and Shared Memory Multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse Scale Computers – Introduction to Multiprocessor Network Topologies.

System Fundamentals Laboratory (PCCS4030L)

List of Laboratory Experiments

Suggested Experiments:(At least 10 experiments)

1. Explore the internal commands of Linux and Write shell scripts to do the following:
   - Display top 10 processes in descending order.
   - Display processes with highest memory usage.
   - Display current logged in user and logname.
   - Display current shell, home directory, operating system type, current path setting, current working directory.
   - Display OS version, release number, kernel version.
   - Illustrate the use of sort, grep, awk, etc.
2. Implement Booth's multiplication algorithm.
3. Implement Restoring and Non-Restoring division algorithm.
4. Implement Direct memory mapped cache organization.
5. Implement Fully associative and set associative cache memory mapping.
6. Implement various cache/page replacement policies.
7. Implement CPU scheduling algorithms like FCFS, SJF, Round Robin etc.
8. Implement Best Fit, First Fit and Worst Fit Memory allocation policy.
9. Implement Producer -Consumer problem with Semaphore.
10. Implement order scheduling in supply chain using Banker's Algorithm.
11. Implement Disk Scheduling Algorithms.

12. Implement Multithreading.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. William Stallings, "Computer Organisation and Architecture", 8^{th} Edition, Pearson.
2. Greg Gagne, Abraham Silberschatz, Peter B. Galvin ,"Operating System Concepts", 9^{th} Edition, John Wiley & Sons.

Reference Books:

1. John Hayes, "Computer Architecture and Organization", 3^{rd} Edition, McGrawHill.
2. M. Morris Mano, "Computer System Architecture", 3^{rd} Edition, Pearson.
3. Andrew S. Tanenbaum and Todd Austin, "Structured Computer Organization", 6^{th} Edition, PHI.
4. M. Murdocca and V. Heuring, "Computer Architecture and Organization", 1^{st} Edition, WILEY.
5. Andrew S. Tanenbaum, "Modern Operating Systems", 4^{th} Edition, PHI.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Design and Analysis of Algorithms (PCCS4040T)		
Design and Analysis of Algorithms Laboratory (PCCS4040L)		

Prerequisite: Data Structures, Mathematics.

Course Objective(s):

The objective of the course is to introduce important algorithmic design paradigms and approaches for effective problem solving. To analyze the algorithm for its efficiency to show its effectiveness over the others. In addition, the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems will be introduced.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze the performance of algorithms using asymptotic analysis.	L4	Analyze
CO2	Solve the problem using appropriate algorithmic design techniques.	L3	Apply
CO3	Justify the classification of certain problems as NP-Complete.	L5	Evaluate

Design and Analysis of Algorithms (PCCS4040T) Course Contents

Unit-I 04 Hrs.

Analysis of Algorithm: The Efficient Algorithm, Average, Best and Worst Case Analysis, Amortized Analysis, Asymptotic Notations, Analyzing Control Statement, Loop Invariant and the Correctness of the Algorithm.

Unit-II 06 Hrs.

Divide and Conquer Algorithm: Introduction, Recurrence and Different Methods to Solve Recurrence, Substitution and Hash Techniques, Multiplying Large Integers Problem, Problem Solving using Divide and Conquer Algorithm -Max-Min Problem, Large Integer, Matrix Multiplication.

Unit-III 08 Hrs.

Greedy Algorithm: General Characteristics of Greedy Algorithms, Problem Solving using -Activity Selection Problem, Elements of Greedy Strategy, Minimum Spanning Trees (Kruskal's Algorithm, Prim's Algorithm), Graphs: Shortest Paths, The Knapsack Problem, Job Scheduling Problem, Optimal Merge Pattern, Huffman Code, Coin Change Problem.

Unit-IV 10 Hrs

Dynamic Programming: Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating The Binomial Coefficient, Making Coin Change Problem, Assembly Line-Scheduling, Knapsack Problem, Multistage Graphs, All Pairs Shortest Path, Matrix Chain Multiplication, Longest Common Subsequence, Travelling Salesman Problem, OBST, Johnson's Algorithm for Flow Shop Scheduling.

Unit-V 10 Hrs.

Backtracking: Introduction, The Eight Queen's Problem, Sum of Subsets, Hamiltonian Cycle.

Branch and Bound: Introduction, FIFO BB, LIFO BB, LC BB, Fifteen Puzzle Problem, Knapsack Problem, Travelling Salesman Problem, Job Scheduling.

String Matching: Introduction, The Naive String-Matching Algorithm, The Rabin-Karp Algorithm, String Matching with Finite Automata, The Knuth-Morris-Pratt Algorithm.

Unit-VI 04 Hrs.

Introduction to NP-Completeness: The class P and NP, Polynomial Reduction, NP-Comple Problem, NP-Hard Problems. Travelling Salesman Problem, Hamiltonian Problem, Approxin

Algorithms.

Design and Analysis of Algorithms Laboratory (PCCS4040L)

List of Laboratory Experiments

Suggested Experiments:(At least 12 experiments)

1. Implementations of Quick Sort and Merge Sort.
2. Implementations of Knapsack problem.
3. Implementations of Job Sequencing with deadlines.
4. Implementation of Prims's and Kruskal's method.
5. Implementation of Shortest paths algorithms (Dijkstra's algorithm and Bellman-ford algorithm).
6. Implementation of Multistage graphs (Forward and Backward) algorithm.
7. Implementation of Floyd Warshall Algorithm.
8. Implementation of Matrix Chain Multiplication.
9. Implementation of Optimal binary search tree.
10. Implementation of 0/1-Knapsack.
11. Implementation of Travelling salesperson problem.
12. Implementation of Johnson's Algorithm for 2 machines and 3 machines scenarios.
13. Implementation of Longest Common Subsequence (LCS).
14. Implementation of 8 queen problem.
15. Implementation of Sum of subsets.
16. Implementation of 15 puzzle problem.
17. Implementation of Graph coloring.
18. Implementation of Travelling salesperson problem using branch and bound.
19. Implementation of 0/1-Knapsack using branch and bound.

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the prac

performed during laboratory sessions.

Text Books:

1. S. Sridhar, "Design and Analysis of Algorithms", 1st Edition, Oxford Education, 2018.
2. Ellis Horowitz and Sartaj Sahni,"Fundamentals of Computer Algorithms", 2nd Edition, Galgotia, 2012.
3. Steven S Skiena, "The Algorithm Design Manual", Springer International Publications.

Reference Books:

1. Kleinberg and Tardos, "Algorithm Design", 1st Edition, Addison-Wesley, 2006.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, "Introduction to Algorithms",3rd Edition, The MIT Press, 2009.
3. Aho, Hopcroft, Ullman, "Design and analysis of Algorithm", 1st Edition, Addison-Wesley, 2000.
4. David Harel, "Algorithmics-The spirit of computing", 3rd Edition, Addison-Wesley, 2004.
5. Knuth, "Fundamentals of Algorithms", 3rd Edition, Narosa Publication, 1998.
6. Herbert S. Wilf, "Algorithms and Complexity", 2nd Edition, PHI, 2002.
7. S. E. Goodman and S. T. Hedetniemi, "Introduction to the Design and Analysis of Algorithms", McGraw Hill, 1988.
8. Sara Baase, Allen Van Gelder,"Computer Algorithms Introduction to Design and Analysis", 3rd Edition, Addison- Wesley, 2000.
9. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", 4th Edition, PHI, 2000.
10. Harsh Bhasin, "Algorithms: Design and Analysis", 1st Edition, Oxford, 2015.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Universal Human Values (HMCS4050T)		

Prerequisite: Nil

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Identify the need, relevance, and role of universal human values in personal, academic, and professional life.	L2	Understand
CO2	Demonstrate understanding of self-exploration, harmony in human relationships, and ethical conduct in daily interactions.	L3	Apply
CO3	Apply principles of trust, respect, and responsibility to foster sustainable and compassionate social environments.	L3	Apply
CO4	Analyze the interdependence between individual values, societal well-being, and ecological balance.	L4	Analyze
CO5	Use human values in decision-making processes for holistic development and responsible engineering practice.	L3	Apply

Universal Human Values (HMCS4050T)
Course Contents

Unit-I Introduction: Need, Basic Guidelines, Content and Process for Value Education 05 Hrs.

Purpose and Motivation for the Course. Self-Exploration–What Is It? - Its Content and Process; 'Natural Acceptance' and Experiential Validation- As the Process for Self-Exploration.

Continuous Happiness and Prosperity- A Look at Basic Human Aspirations.

Right Understanding, Relationship and Physical Facility- The Basic Requirements for Fulfilment of Aspirations of Every Human Being with their Correct Priority.

Understanding Happiness and Prosperity Correctly- A Critical Appraisal of the Current Scenario.

Method to Fulfil the Above Human Aspirations: Understanding and Living In Harmony at Various Levels.

Unit-II Understanding Harmony in the Human Being - Harmony in Myself! 06 Hrs.

Understanding Human Being as a Co-Existence of the Sentient 'I' and the Material 'Body'.

Understanding the Needs of Self ('I') and 'Body' - Happiness and Physical Facility.

Understanding the Body as an Instrument of 'I' (I Am Being The Doer, Seer and Enjoyer).

Understanding the Characteristics and Activities of 'I'and Harmony In 'I'.

Understanding the Harmony of I with The Body: Sanyam and Health; Correct Appraisal of Physical Needs, Meaning of Prosperity In Detail.

Programs to Ensure Sanyam and Health.

Unit-III Understanding Harmony in the Family and Society: Harmony in Human-Human Relationship. 06 Hrs.

Understanding Values in Human-Human Relationship; Meaning of Justice (Nine Universal Values in Relationships) and Program for Its Fulfilment to Ensure Mutual Happiness; Trust and Respect as the Foundational Values of Relationship.

Understanding the Meaning of Trust; Difference between Intention and Competence.

Understanding the Meaning of Respect, Difference between Respect and Differentiation; The other Salient Values in Relationship.

Understanding the Harmony in the Society (Society Being an Extension of Family): Resolution, Prosperity, Fearlessness (Trust) and Co-Existence as Comprehensive Human Goals.

Visualizing a Universal Harmonious Order in Society- Undivided Society, Universal Order- From Family to World Family.

Unit-IV Understanding Harmony in the Nature and Existence: Whole existence as Coexistence 05 Hrs.

Understanding the Harmony in the Nature 19. Interconnectedness and Mutual Fulfilment Among the Four Orders of Nature Recyclability and Self-Regulation in Nature.

Understanding Existence as Co-Existence of Mutually Interacting Units in All Pervasive Space. Holistic Perception of Harmony at All Levels of Existence.

Unit-V Implications of the above Holistic Understanding of Harmony on Professional Ethics 06 Hrs.

Natural Acceptance of Human Values 23. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution fnd Humanistic Universal Order. Competence in Professional Ethics:

1. Ability to utilize the professional competence for augmenting universal human order.
2. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems.
3. Ability to identify and develop appropriate technologies and management patterns for above production systems.

Case Studies of Typical Holistic Technologies, Management Models and Production Systems. Strategy for Transition from the Present State to Universal Human Order:

1. At the level of individual: As socially and ecologically responsible engineers, technologists, and managers.
2. At the level of society: As mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria ,"Human Values and Professional Ethics", Excel Books, New Delhi, 2010

Reference Books:

1. A Nagaraj, "Jeevan Vidya: EkParichaya" Jeevan Vidya Prakashan, Amarkantak, 1999.
2. A.N. Tripathi, "Human Values," New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi,"The Story of My Experiments with Truth" .
5. E. F Schumacher, "Small is Beautiful".
6. Cecile Andrews, "Slow is Beautiful".

7. J C Kumarappa, “Economy of Permanence”.

8. PanditSunderlal, “Bharat Mein Angreji Raj”.

9. Dharampal, “Rediscovering India”.

10. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”.

11. Maulana Abdul Kalam Azad, “India Wins Freedom”.

12. Romain Rolland , “Vivekananda”.

13. Romain Rolland, “Gandhi”.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Web Engineering Laboratory (PCCS4060L)		

Prerequisite: Programming Fundamentals

Course Objective(s):

The objective of this lab is to provide the basic framework of web development (MERN Stack) and cloud computing.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Develop a website as per the requirements.	L6	Create
CO2	Apply the concepts of cloud computing to improve the efficiency of web development.	L3	Apply
CO3	Evaluate the requirement of the problem and select appropriate method of web development.	L5	Evaluate

Web Engineering Laboratory (PCCS4060L)

List of Laboratory Experiments

Suggested Experiments:(Any 10)

- HTML
  - Create a static web page using HTML.
  - Create a class timetable using HTML.
  - Create a registration form using HTML.
  - Create a web page using HTML5 tags.
- CSS
  - Design a web page using External or Embedded Style Sheet.
  - Design a responsive web page using media queries and CSS3.
  - Design a web page using Bootstrap.
  - Design a resume using Bootstrap.
  - Design the admission form using Bootstrap.
- Client-Side Scripting
  - Programs based on objects in JavaScript.
  - Program to design a calculator using JavaScript.
  - Programs based on form validation.
- React JS
  - Create an application using React.
  - Introduction to Git and GitHub
  - Introduction to Version Control
  - Using Git Locally and Remotely
  - Collaboration
- Server-Side Scripting
  - Installation and Configuration of Node.js server
  - Program based on inbuilt functions in Node.js
- Express and MongoDB
  - Using Mongoose to make schemas in MongoDB.

  - Making API end points using Express.
  - Doing CRUD on database MongoDB using Express.
  - Writing tests using mocha and chai.

- XML and XSL
  - Design XML using XML DTD and schema.
  - Implementing XSL elements in XML.
  - Validating XML data through DTD and storing in database.

- Concepts of Cloud Computing
  - Introduction to cloud computing.
  - NIST model
  - Service and Deployment models.

- Networking and Security
  - Identity and Access Management
  - Networking basics
  - VPC networking and security
  - Design a VPC
  - Build your own VPC and Launch a Web Server

- Compute Service
  - Compute Services overview
  - Elastic Computing
  - Serverless Compute service
  - Deploying and scaling web applications

- Storage Service
  - Cloud object storage
  - Cloud block storage
  - Elastic file system

- Database Service
  - Cloud Relational database services
  - Cloud NoSQL Databases

- Elastic load balancing

Any other experiment based on syllabus may be included which would help the learner to understand topic/concept.

Oral/Practical examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

Text Books:

1. Vasan Subramanian,"Pro MERN Stack", 2nd Edition, Apress Publication.
2. Shama Hoque, "Full-Stack React Projects", 2nd Edition, Packt Publication.
3. Rajkumar Buyya, James Broberg, Goscinki,"Cloud Computing: Principles and Paradigms", Wiley.

Reference Books:

1. Benjamin LaGrone, "HTML5 and CSS3 Responsive Web Design Cookbook", 1st Edition, Packt Publishing, 2013.
2. DT Editorial Services, "Web Technologies: Black Book", 1st Edition, Dreamtech Press, 2018.
3. Christopher Schmitt, Kyle Simpson, "HTML5 Cookbook", 1st Edition, O'Reilly Media Inc., 2011.
4. Uttam K. Roy, "Web Technologies", 1st Edition, Oxford University Press, 2010.
5. Greg Sidelnikov, "React. Js Book: Learning React JavaScript Library from Scratch", 1st Edition, Independently Published, 2017.
6. DT Editorial Services, "HTML5 Black Book", 2nd Edition, Dreamtech Press, 2016.
7. Ben Frain, "Responsive Web Design with HTML5 and CSS3", 2nd Edition, Packt Publishing, 2015.
8. Steve Suehring, "JavaScript Step by Step", 3rd Edition, Pearson Education, 2013.
9. Stoyan Stefanov, "React Up Running Building Web Applications", 1st Edition, O'Reilly Media Inc., 2016.
10. Velte, "Cloud Computing a Practical Approach", Tata McGraw-Hill Education.
11. Sandip Bhowmik, "Cloud Computing", Cambridge University Press, 2017.

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech.	Semester: IV
Semester Project-II (PJCS4070L)		

Course Objective(s): Students are expected to design, simulate/implement a project based on the knowledge acquired from current semester subjects.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Analyze a survey of several available literatures in the preferred field of study.	L4	Analyze
CO2	Describe various/alternate approaches to complete a project.	L2	Understand
CO3	Apply a collaborative project environment by interacting and dividing project work among team members.	L3	Apply
CO4	Use technical communication skills to present project work in the form of a technical report/paper.	L3	Apply
CO5	Apply teamwork and project management skills to plan, execute, and manage the research study.	L3	Apply

Semester Project:

The purpose of introducing semester project at second year level is to provide exposure to students with a variety of projects based on the knowledge acquired from the semester subjects. This activity is supposed to enrich their academic experience and bring enough maturity in student while selecting the project. Students should take this as an opportunity to develop skills in implementation, presentation and discussion of technical ideas/topics. Therefore, proper attention shall be paid to the content of semester project report which is being submitted in partial fulfillment of the requirements of the Second Year and it is imperative that a standard format be prescribed for the report.

Each student shall work on project approved by departmental committee approved by the Head of Department, a group of 03 to 05 students (max allowed: 5 students in extraordinary cases, subject to the approval of the departmental committee and the Head of the department) shall be allotted for each Semester Project. Each group shall submit at least 3 topics for the Semester Project. The departmental committee shall finalize one topic for every group. Semester Project Title or Theme should be based on knowledge acquired during semester. The project work shall involve sufficient work so that students get acquainted with different aspects of knowledge acquired from semester subjects.

Student is expected to:

- Select appropriate project title based on acquired knowledge from current semester subjects.
- Maintain Log Book of weekly work done (Log Book Format will be as per Table 4).
- Report weekly to the project guide along with log book.

Assessment Criteria:

- At the end of the semester, after confirmation by the project guide, each project group will submit project completion report in prescribed format for assessment to the departmental committee (including project guide).
- Assessment of the project (at the end of the semester) will be done by the departmental committee (including project guide).

Prescribed project report guidelines:

Size of report shall be of minimum 25 pages. Project Report should include appropriate content for:

- Introduction
- Literature Survey
- Related Theory
- Implementation details

- Project Outcomes
- Conclusion
- References

Assessment criteria for the departmental committee (including project guide) for Continuous Assessment:

Guide will monitor weekly progress and marks allocation will be as per Table 5.

Assessment criteria for the departmental committee (including project guide) for End Semester Exam:

Departmental committee (including project guide) will evaluate project as per Table 6.

Table 4: Log Book Format

Sr	Week (Start Date:End Date)	Work Done	Sign of Guide	Sign of Coordinator
1				
2				

Table 5: Continuous Assessment Table

Sr	Exam Seat No	Name of Student	Student Attendance	Log Book Maintenance	Literature Review	Depth of Understanding	Report	Total
			5	5	5	5	5	25

Table 6: Evaluation Table

Sr	Exam Seat No	Name of Student	Project Selection	Design/ Methodology	Implementation	Result Verification	Presentation	Total
			5	5	5	5	5	25

Program: Computer Science & Engineering (Data Science)	S. Y. B.Tech	Semester: IV
Employability Skill Development Program-I (HMCS4080)		

Course Objectives:

1. To enhance the problem solving skills.
2. To improve the basic mathematical skills for solving real life examples.
3. Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
4. Demonstrate an understanding of computer programming language concepts.

Course Outcomes:

On completion of the course, the learner will be able to:

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	Explain the basic concepts of Quantitative Ability, including profit, loss, time, work, and geometry.	L2	Understand
CO2	Demonstrate the concepts of Quantitative Ability for problem solving.	L3	Apply
CO3	Demonstrate the concept of Variables and Functions through examples.	L3	Apply
CO4	Demonstrate the concept of Multithreading and String Handling.	L3	Apply
CO5	Explain the fundamentals of Object-Oriented Programming.	L2	Understand
CO6	Describe the concepts of Distributed Database.	L2	Understand

Employability Skill Development Program-I (HMCS4080) Course Contents

Unit-I Aptitude 08 Hrs.

Quantitative Aptitude : Algebra, Profit and Loss, Average & Allegation / Mixture, Time and Work, Geometry Mensuration, Numbers , Percentage, Permutation and Combination, Probability, Ratios & Proportion, Time and Distance. Reasoning : Analytical, Puzzles, Blood relationship, Data Interpretation, Data sufficiency

Unit-II Fundamental of Programming 20 Hrs.

Variables: Local variables, Global variables, 'global' keyword, Rules of Identities,

Functions : Introduction, Prototype, Classification of functions, No arguments and No return values, With arguments and With return values.

No arguments and With return values : With arguments and No return values, Recursion, Argument type functions, Default arguments functions, Required arguments functions, Keyword arguments functions, Variable arguments function.

Operators : Arithmetic Operators, Relational operators, Logical operators, Bitwise operators, Shift operators.

Control Statements : Conditional Control Statements, if, if-else, if-elif-else, nested-if, Loop Control Statements, While, For.

Branching Statements: Break, Continue, pass, return, exit.

Exception Handling: Introduction, The need of exception handling, Getting exceptions, Default exception handler, Handling exception, Try, Except, Try with multiple except blocks Handling exceptions using Exception class, Finally, block, Releasing resources using Finally block, Raise, Creating a user exception class., Raise exception manually, Exceptions based application.

Multithreading : Introduction, Multitasking, Multi tasking v/s Multithreading, threading module, Thread class introduction, Creating thread, The life cycle of a thread, Single-threaded application, Multi-threaded application, Sleep() method. Sleep() v/s run(), Join() v/s Sleep(), Multiple custom threads creation, The execution time of single-threaded application, The execution time of multi-threaded application, Synchronization of threads. Inner classes basic syntax of inner class, Advantages of Inner classes, Access class level members of inner classes, Access object level members of inner classes, Local inner classes, Complex inner classes, Accessing data of inner classes.

Regular expressions:'re' module, Match(), Search(), find() etc, and actual projects web scrapping Mail extraction Date extraction, Mobile number extraction, Vehicle number extraction, zoom chat analysis, Expressions using operators and symbols: Split string into characters, Split string into v Lambda expressions.

String handling using regex: Introduction to Strings, Indexing and Slicing, Special operators in String handling, Old style String formatting, String library methods, Quotes and Escape characters in a String representation, String Immutability, Logical programs using Strings.

Object Oriented Programming : Introduction to OOPs, Classes, Objects, Structure to OOP application, Contexts of OOP application, Class level members, Object level members, self variable, Constructor and Initialization of object. Access modifiers : Private, Protected, Public, Program codes. Encapsulation Rules, Implementation, Abstraction, Polymorphism Inheritance Introduction, Types of Inheritance, Single inheritance, Multi-Level inheritance, Method overriding, Object initialization using constructor, Multiple inheritances, Hierarchical inheritance, Method overriding in Multi level inheritance.

Reference Books:

1. Dr. R S Aggarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publication
2. M. G. Venkateshmurthy, "Programming Techniques through C", Pearson Publication.
3. Behrouz Forouzan, "A Computer Science Structure Programming Approaches using C", Cengage Learning.
4. Yashwant Kanetkar, "Let Us C", BPB Publication.

Evaluation Scheme:

Teacher Assessment(TA):

Teacher's Assessment (TA) will carry weightage of 50 marks. The components of TA are

1. MCQ Test based on Aptitude: 20 Marks
2. MCQ Test based on Programming skills: 30 Marks
3. Total Marks: 50 Marks