Study Scheme of M. Tech. Information Technology

Programme Name M. Tech. Information Technology
Curriculum applicable to AY 2025-26 onwards
Curriculum Version: 1.0
Approved by / Date BoS / 22-May -2025

SEMESTER 1st		Contact Hours/Week			Maximum Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
25C1ITP-101	Mathematical Foundations of Computer Science	3	0	0	40	60	100	3
25C1ITP-102	Advanced Data Structures	3	0	0	40	60	100	3
25C1ITP-PE1-XX	Program Elective-I 01- Data Sciences 02- Distributed Systems 03- Operating System Design	3	0	0	40	60	100	3
25C1ITP-PE2-XX	Program Elective-II 01- Data Warehousing and Mining 02- Mobile Applications and Services 03- Network Security	3	0	0	40	60	100	3
25C1ITP-111	Lab Based on Electives	0	0	4	60	40	100	2
25C1CCP-01	Research Methodology & IPR	2	0	0	40	60	100	2
25C1CCP-XX	Audit course-I	2	0	0	S/US	0	0	0
25C1ITP-112	Advanced Data Structures Lab	0	0	4	60	40	100	2
Total		16	0	8	320	380	700	18
Total Contact Hours/Week = 24								
Total number of credits for the program will be as per guidelines given by AICTE/UGC/IKGPTU								

SEMESTER 2nd		Contact Hours/Week			Maximum Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
25C1ITP-201	Advanced Algorithms	3	0	0	40	60	100	3
25C1ITP-202	Soft Computing	3	0	0	40	60	100	3
25C1ITP-PE3-XX	Program Elective-III 01-Big Data Analysis 02-Cloud Computing 03-Intrusion Detection	3	0	0	40	60	100	3
25C1ITP-PE4-XX	Program Elective-IV 01-Data Visualization 02-Machine Learning 03-Wireless Sensor Network	3	0	0	40	60	100	3
25C1CCP-XX	Audit Course-II	2	0	0	S/US	0	0	0
25C1ITP-211	Lab Based on Cores - Advanced Algorithms Lab	0	0	4	60	40	100	2
25C1ITP-212	Lab Based on Electives	0	0	4	60	40	100	2
25C1ITP-203	Minor Project with Seminar	2	0	0	40	60	100	2
Total		**16**	**0**	**8**	**360**	**440**	**800**	**18**
Total Contact Hours/Week = 24								
Total number of credits for the program will be as per guidelines given by AICTE/UGC/IKGPTU								

Details of Audit courses-I

Subject Code	Subject Name
25C1CCP –02	English for Research Paper Writing
25C1CCP –03	Disaster Management
25C1CCP –04	Sanskrit for Technical Knowledge
25C1CCP –05	Stress Management by Yoga

Details of Audit courses-II

Subject Code	Subject Name
25C1CCP –06	Value Education
25C1CCP –07	Constitution of India
25C1CCP –08	Pedagogy Studies
25C1CCP –09	Personality Development through Life Enlightenment Skills.

Course title	**Mathematical Foundations of Computer Science**
Course Code	**25C1ITP-101**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**Discrete Mathematics**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	identify the characteristics of different discrete and continuous distributions and the type of statistical situation in which different distributions can be applied.
CO2	analyze the theory of sampling distribution and maximum likelihood estimation.
CO3	make use of graphs as a unifying theme for various combinatorial problems.
CO4	interpret the methods of statistical inference and the role that sampling distributions play in those methods.
CO5	develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.

Detailed contents:

UNIT 1: (7 Hours)
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.

UNIT 2: (7 hours)
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.

UNIT 3: (8 hours)
Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

UNIT 4: (11 hours)
Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems.

UNIT 5: (10 hours)
Computer Science and Engineering applications:
Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.

UNIT 6: (5 hours)
Recent Trends in various distribution functions in the mathematical field of computer science for varying fields like bioinformatics, soft computing, and computer vision.

Suggested Readings/Books:
1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Course title	**Advanced Data Structures**
Course Code	**25C1ITP-102**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**UG level course in Data Structures**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Choose appropriate data structures and algorithms, understand the concept of advanced abstract data type and use it to design algorithms to solve complex engineering problems.
CO2	Construct various symbol tables using hash techniques to solve problems efficiently and provide a better solution in terms of complexity.
CO3	Identify various algorithms like skip list & trees and come up with analysis of efficiency and proofs of correctness.
CO4	Develop algorithms for text processing applications and analyze their performance.
CO5	Select algorithm design approaches to solve computational geometry problems in a specific manner to improve performance.

Detailed contents:

UNIT 1: (7 hours)
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate chaining, Open Addressing, Linear Probing, Quadratic, Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT 2: (5 hours)
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

UNIT 3: (9 hours)
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

UNIT 4: (12 hours)
Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT 5: (10 hours)
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees.

UNIT 6: (5 hours)
Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem.

Suggested Readings/Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course title	**Data Sciences**
Course Code	**25C1ITP-PE1-01**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**UG level course in Algorithm Design and Analysis**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	illustrate with the knowledge and expertise to become a proficient data scientist.
CO2	analyze statistics and machine learning concepts that are vital for data science.
CO3	build Python code to statistically analyze a dataset.
CO4	evaluate data visualizations based on their design and use for communicating stories from data.
CO5	create database connectivity with the front end.

Detailed contents:

UNIT 1: 6 Hours

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT 2: 7 hours

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources.

UNIT 3: 10 Hours

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT 4: 11 Hours

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT 5: 7 Hours

Applications of Data Science, Technologies for visualization, Bokeh (Python)

UNIT 6: 7 Hours

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science.

Suggested Readings/Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk fromthe Frontline. O'Reilly.
2. Jure Leskovek, A.Rajaraman and J.Ullman. Mining of Massive Datasets. v2.1.

Course title	**Distributed Systems**
Course Code	**25C1ITP-PE1-02**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**DataBase Management System**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	inspect the architecture and transparency features of Distributed Database Management Systems.
CO2	identify design strategies such as fragmentation and data allocation in distributed databases.
CO3	interpret the process of query decomposition and optimization in distributed environments.
CO4	apply concurrency control and recovery mechanisms to ensure transaction reliability.
CO5	design distributed solutions using advanced topics like mobile databases and multi-database systems.

Detailed contents:

UNIT 1: 8 hours

Introduction: Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts

Distributed Database Management System Architecture: Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues.

UNIT 2: 11 hours

Distributed Database Design: Alternative design strategies; Distributed design issues; Fragmentation; Data allocation.

Semantics Data Control: View management; Data security; Semantic Integrity Control.

Query Processing Issues: Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.

UNIT 3: 11 hours

Distributed Query Optimization: Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms.

Transaction Management: The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models.

Concurrency Control: Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.

UNIT 4: 8 hours

Reliability: Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols.

UNIT 5: 6 hours

Parallel Database Systems: Parallel architectures; parallel query processing and optimization; load balancing.

UNIT 6: 5 hours

Advanced Topics: Mobile Databases, Distributed Object Management, Multi-databases.

Suggested Readings/Books:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Course title	**Operating System Design**
Course Code	**25C1ITP-PE1-03**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**Data Structure, Algorithms, Computer Architecture and Organization**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Describe the functions, structures, and design approaches of various types of advanced operating systems.
CO2	Explain process management concepts, system calls, and thread models in modern operating systems.
CO3	Analyze scheduling algorithms, synchronization techniques, and deadlock handling mechanisms in uniprocessor and multiprocessor environments.
CO4	Apply memory management strategies, virtual memory, I/O handling, and OS-level security practices.
CO5	Design distributed and multiprocessor operating system components with an emphasis on architecture, synchronization, and fault tolerance.

Detailed contents:

UNIT 1: 8 hours

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems.

UNIT 2: 8 hours

Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and micro-kernels.

UNIT 3: 10 hours

Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies.

UNIT 4: 7 hours

Memory management, Virtual memory concept, Virtual machines, I/O management, File and disk management, Operating system security.

UNIT 5: 11 hours

Distributed Operating system: Architecture, Design issues, distributed mutual exclusion, distributed deadlock detection, shared memory, Distributed scheduling. Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.

UNIT 6: 4 hours

Recent trends in Operating system design and their applicability to HPC.

Suggested Readings/Books:

1. Advanced concept in operating system: M.Singhal, N.G. Shivratri
2. Operating system internal and design principles: William Stallings

Course title	**Data Warehousing and Mining**
Course Code	**25C1ITP-PE2-01**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**Databases, Probabilities**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Describe the foundational concepts of data warehousing, frequent pattern mining, and sequential pattern mining methods.
CO2	Explain classification, clustering techniques, and temporal pattern mining with their relevance to real-world datasets.
CO3	Analyze time series data using periodicity and trend detection techniques for similarity and predictive tasks.
CO4	Apply data stream mining, stream classification, and graph-based mining techniques including social network analysis.
CO5	Evaluate modern approaches in web mining and distributed data mining, including multimedia and web structure mining.

Detailed contents:

UNIT 1: 7 hours
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;

UNIT 2: 8 hours
Classification and prediction; Cluster Analysis–Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,

UNIT 3: 8 hours

Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;

UNIT 4: 11 hours

Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;

UNIT 5: 9 hours

Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.

UNIT 6: 5 hours

Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis

Suggested Readings/Books:

1. Jiawei Han and MKamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining-Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. GDongand J Pei, Sequence Data Mining, Springer, 2007.

Course title	**Mobile Applications and Services**
Course Code	**25C1ITP-PE2-02**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**Wireless Communication and Mobile Computing**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Identify the target platform, user requirements, and tools required to define and sketch mobile applications.
CO2	Describe mobile development environments, UI frameworks, and techniques for storing and retrieving data in Android.
CO3	Apply concepts of mobile networking, telephony, notifications, and performance optimization in mobile applications.
CO4	Design a mobile application prototype using Android, incorporating multimedia features, location-based services, and deployment strategies.
CO5	Evaluate mobile app development challenges including platform limitations, security threats, testing techniques, and IoT integration trends.

Detailed contents:

UNIT 1: 8 Hours

Introduction: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development Android User.

UNIT 2: 8 Hours

More on Uis: VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal Uis, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider.

UNIT 3: 10 Hours

Communications via Network and the Web: State Machine, Correct Communications Model, Android Networking and Web, Telephony Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony.

Notifications and Alarms: Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics.

UNIT 4: 9 Hours

Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App, Location Mobility and Location Based Services Android.

Multimedia: Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.

UNIT 5: 8 Hours

Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing, Security and Hacking, Active Transactions, more on Security, Hacking Android.

UNIT 6: 5 hours

Recent trends in Communication protocols for IOT nodes, mobile computing techniques in IOT, agents based communications in IOT.

Suggested Readings/Books:

1. Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley & Sons

Course title	**Network Security**
Course Code	**25C1ITP-PE2-03**
Scheme and Credits	**L T P C** **Semester – I** **3 0 0 3**
Pre-requisite (if any)	**Computer Networks, Web Programming**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Explain cryptographic techniques, including RSA, DES, and ECC, and their applications in data security.
CO2	Evaluate authentication methods, digital signatures, and cryptographic protocols such as Kerberos, and analyze attacks on these protocols.
CO3	Apply network and transport security mechanisms, including firewalls, SSL/TLS, and IP Sec, to protect communication channels.
CO4	Analyze web security issues like SQL injection, XSS, buffer overflows, and malware, and develop strategies for mitigating these risks.
CO5	Design and implement secure e-commerce systems, biometric authentication methods, and wireless communication security protocols.

Detailed contents:
UNIT 1: 6 lectures
Data security: Review of cryptography. Examples: RSA, DES, ECC.

UNIT 2: 9 Lectures
Authentication, non-repudiation and message integrity. Digital signatures and certificates. Protocols using cryptography (example Kerberos). Attacks on protocols.

UNIT 3: 9 Lectures
Network security: Firewalls, Proxy-Servers, Network intrusion detection.
Transport security: Mechanisms of TLS, SSL, IP Sec

UNIT 4: 11 Lectures
Web security- SQL injection, XSS, etc. Software security and buffer overflow. Malware types and case studies.
Access Control, firewalls and host/ network intrusion detection.

UNIT 5: 8 Lectures
Other topics: Biometric authentication, Secure E-Commerce (ex.SET), Smart Cards, Security in Wireless Communication.

UNIT6: 5 lecture
recent trends in IOT security, IDS and Biometric.

Suggested Readings/Books:
1. W.R. Cheswick and S.M. Bellovin. Firewalls and Internet Security. Addison Wesley, 1994.
2. W.Stallings. Cryptography and Network Security. Prentice Hall, 1999.

Course title	**Research Methodology and IPR**
Course Code	**25C1CCP-01**
Scheme and Credits	**L T P C** **Semester – I** **2 0 0 2**
Pre-requisite (if any)	**Probability and Statistics**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	summarize research problem formulation
CO2	analyse research related information
CO3	plan a well-structured research paper and scientific presentations
CO4	assess various IPR components and process of filing
CO5	infer the adequate knowledge on patent and rights

Detailed contents:

UNIT 1: (10 Hours)
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT 2 : (5 Hours)
Effective literature studies approaches, analysis Plagiarism, Research ethics,

UNIT 3: (7 hours)
Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT 4: (8 Hours)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT 5: (7 hours)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 6: (8hours)

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested Readings/Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course title	**Advanced Data Structures Lab**
Course Code	**25C1ITP-112**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Analyze algorithms and to determine algorithm correctness and complexity using hashing techniques
CO2	Design programs using a variety of data structures, including list, tree structures and analyse their complexity
CO3	Implement and know the application of algorithms for computational geometry problems
CO4	Illustrate how text processing algorithms can be used to solve various real time problems.
CO5	Apply algorithms to design techniques in a project to get exposure to solve problems

Detailed contents:

Experiment 1: WAP to store k keys into an array of size n at the location computed using a hash function, loc = key % n, where k<n and k takes values from [1 to m], m>n. To handle the collisions use the following collision resolution techniques

a. Linear probing
b. Quadratic probing
c. Double hashing/rehashing
d. Chaining

Experiment 2: WAP for Binary Search Tree to implement following operations:

a. Insertion

b. Deletion i. Delete node with only child ii. Delete node with both children
c. Finding an element
d. Finding Min element
e. Finding Max element
f. Left child of the given node
g. Right child of the given node
h. Finding the number of nodes, leaves nodes, full nodes, ancestors, descendants.

Experiment 3: WAP for AVL Tree to implement the following operations: (For nodes as integers)
a. Insertion: Test program for all cases (LL, RR, RL, LR rotation)
b. Deletion: Test Program for all cases (R0, R1, R-1, L0, L1, L-1)
c. Display: using set notation.

Experiment 4: WAP to implement Red-Black trees with insertion and deletion operation for the given input data as Integers/Strings

Experiment 5: WAP to implement insertion, deletion, display and search operation in m-way B tree (i.e. a non-leaf node can have at most m children) for the given data as integers.

Experiment 6: WAP to perform string matching using Knuth-Morris-Pratt algorithm.

Experiment 7: WAP to perform string matching using Boyer-Moore algorithm.

Experiment 8: WAP to implement 2-D range search over computational geometry problem

Experiment 9: WAP on the latest efficient algorithms on trees for solving contemporary problems.

Experiment 10: Mini Project: Students have to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Data Sciences Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Apply R statistical functions to load, manipulate, and save datasets for data analysis tasks.
CO2	Analyze and visualize data using R's graphical functions and descriptive statistics tools to explore and summarize datasets.
CO3	Implement K-means Clustering and evaluate the effectiveness of clustering models using R's visualization capabilities.
CO4	Design and apply machine learning models, such as Naive Bayesian Classifier and Decision Trees, in R to solve classification problems.
CO5	Develop a project using R, incorporating various algorithms and visualization techniques learned during the course to solve real-world problems.

Detailed contents:

Experiment 1: Introduction to R
This Cycle introduces the use of the R statistical package within the Data Science and Big Data Analytics environment. After completing the tasks in this cycle, students should be able to:
Read data sets into R, save them, and examine the contents.
Tasks in this Cycle include:

Invoke the R environment and examine the R workspace.
Create tables and datasets in R.

Examine, manipulate, and save datasets.
Exit the R environment.

Experiment 2: Basic Statistics and Visualization
This Cycle introduces the analysis of data using the R statistical package within the Data Science and Big Data Analytics environment. After completing the tasks in this cycle, students should be able to:
Perform summary (descriptive) statistics on the datasets.
Create basic visualizations using R to support investigation of the data as well as exploration of the data.
Create plot visualizations of the data using a graphics package.
Tasks in this Cycle include:
Reload datasets into the R statistical package.
Perform summary statistics on the data.
Remove outliers from the data.
Plot the data using various methods.

Experiment 3: K-means Clustering
This Cycle is designed to investigate and practice K-means Clustering. After completing the tasks in this cycle, students should be able to:
Use R functions to create k-means Clustering models.
Use ODBC connection to the database and execute SQL statements and load datasets from the database in an R environment.
Visualize the effectiveness of the k-means Clustering algorithm using graphic capabilities in R.
Use the ODBC connection in the R environment to create the average household income from the census database as test data for K-means Clustering.
Use R graphics functions to visualize the effectiveness of the k-means Clustering algorithm.

Experiment 4: : Association Rules
This Cycle is designed to investigate and practice Association Rules. After completing the tasks in this cycle, students should be able to:
Use R functions for Association Rule-based models.
Tasks in this Cycle include:
Use R functions for Association Rule-based models.
Use theR-Studio Environment to code Association Rule models
b. Apply constraints in the Market Basket Analysis methods such as minimum thresholds on support and confidence measures that can be used to select interesting rules from the set of all possible rules.
c. Use R graphics "arules" to execute and inspect the models and the effect of the various

thresholds.

Experiment 5: Linear Regression
a. This Cycle is designed to investigate and practice linear regression. After completing the tasks in This Cycle, one should be able to:
Use R functions for Linear Regression (Ordinary Least Squares - OLS).
Predict the dependent variables based on the model.
Investigate different statistical parameter tests that measure the effectiveness of the model.
Tasks to complete in This Cycle include:
a. Use the R-Studio environment to code OLS models.
b. Review the methodology to validate the model and predict the dependent variable for a set of given independent variables.
c. Use R graphics functions to visualize the results generated with the model.

Experiment 6: Naive Bayesian Classifier
This Cycle is designed to investigate and practice Naive Bayesian classifier. After completing the tasks in This Cycle, one should be able to:
a. Use R functions for Naive Bayesian Classification.
b. Apply the requirements for generating appropriate training data.
c. Validate the effectiveness of the Naive Bayesian Classifier with the big data.
Tasks to complete in This Cycle include:
a. Use R-Studio environment to code the Naive Bayesian Classifier.
b. Use the ODBC connection to the "census" database to create a training data set for Naive Bayesian Classifier from the big data.
c. Use the Naive Bayesian Classifier program and evaluate how well it predicts the results using the training data and then compare the results with original data.

Experiment 7: Decision Trees
This Cycle is designed to investigate and practice Decision Tree (DT) models covered in the course work. After completing the tasks in This Cycle, one should be able to:
a. Use R functions for Decision Tree models.
b. Predict the outcome of an attribute based on the model.
Tasks to complete in This Cycle include:
a. Use the R-Studio environment to code Decision Tree Models.
b. Build a Decision Tree Model based on data whose schema is composed of attributes.
c. Predict the outcome of one attribute based on the model.

Mini Project: Students have to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Distributive System Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Make use of distributed system components to establish an efficient distributed environment.
CO2	Design and implement distributed database systems, ensuring proper management of data and security across multiple nodes.
CO3	Analyze and apply synchronization and concurrency control mechanisms to maintain data consistency and prevent conflicts in distributed systems.
CO4	Implement partitioning strategies and distributed transaction protocols to optimize system performance and ensure data integrity.
CO5	Evaluate and fine-tune system performance using performance tuning techniques to enhance the efficiency of distributed systems.

Detailed contents:

Experiment 1: Installation and configuration of database packages

Experiment 2: Creating and managing database objects (Tables, views, indexes etc.)

Experiment 3: Creating and managing database security through user management.

Experiment 4: Creating and maintaining database links.

Experiment 5: Implement Partitioning on the database tables

Experiment 6: Implement various Transaction concurrency control methods (i.e. lock's) by executing multiple update and queries.

Experiment 7: Performance tuning of SQL queries.

Experiment 8: Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Operating System Design Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Execute various file and directory handling commands in the LINUX operating system.
CO2	Demonstrate knowledge of file access permissions and user management in LINUX.
CO3	Create processes in LINUX using system calls such as fork ().
CO4	Implement inter-process communication (IPC) through pipes and demonstrate process synchronization.
CO5	Develop concurrent applications, such as a client-server model, utilizing threading and synchronization techniques in LINUX.

Detailed contents:

Experiment 1: Execution of various file/directory handling commands.

Experiment 2: To study the various File Access Permission and different types users in LINUX.

Experiment 3: Write a program to create a process in LINUX.

Experiment 4: Write a program to demonstrate a one-way pipe between two Processes.

Experiment 5: Write a program to illustrate IPC through pipe and fork system calls.

Experiment 6: Implement Threading & Synchronization Applications

Experiment 7: Implement concurrent echo client server application

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Data Warehousing & Mining Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Identify and set up a data mining tool for implementing various data mining techniques.
CO2	Apply preprocessing techniques to clean and prepare datasets for analysis.
CO3	Implement the Apriori algorithm to discover association rules in datasets.
CO4	Apply the FP Growth algorithm for association rule mining and compare its performance with Apriori.
CO5	Demonstrate the use of Naïve Bayes for classification and k-means for clustering on given datasets.

Detailed contents:

Experiment 1: Installation and familiarization of Data Mining tool.

Experiment 2: Demonstration of preprocessing on different datasets.

Experiment 3: Demonstration of Association rule process on dataset using Apriori Algorithm

Experiment 4: Demonstration of Association rule process on dataset using FP Growth Algorithm.

Experiment 5: Demonstration of classification rule process on dataset using Naïve Bayes Algorithm

Experiment 6: Demonstration of clustering rule process on dataset using simple k-means

Experiment 7: To list the categorical/nominal attributes & real valued attributes

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Mobile Applications and Services Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Describe the Android platform, tools, and development environment used for mobile app development.
CO2	Design user interfaces and wireframes for mobile applications based on given app ideas.
CO3	Implement Android applications using activity classes, user interface components, and event handling.
CO4	Deploy and run mobile applications using emulators and debugging tools.
CO5	Evaluate mobile applications through UNIT testing, black-box testing, and automated testing methods.

Detailed contents:

Experiment 1: Introduction to Android platform. Introduction to the tools used in the lab. Create a simple application

Experiment 2: Understand the app idea and design user interface/wireframes of mobile app

Experiment 3: Set up mobile app development environment

Experiment 4: Write a program using activity class to show different events.

Experiment 5: Write a program to convert text to speech.

Experiment 6: Develop and debug mobile app components – User interface, services, notifications, broadcast receivers, data components

Experiment 7: Using emulator to deploy and run mobile apps

Experiment 8: Testing mobile app- UNIT testing, black box testing and test automation.

Course title	**Lab Based on Electives I and II** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Network Security Lab**
Course Code	**25C1ITP-111**
Scheme and Credits	**L T P C** **Semester – I** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Install and navigate through network security tools like Wireshark to analyze network traffic.
CO2	Test live network data and manage different file formats for the captured data.
CO3	Inspect various network activities, including packet loss, packet discard, and protocol performance.
CO4	Implement a program for packet sniffing to analyze network traffic and identify potential vulnerabilities.
CO5	Analyze and test network packets for protocols like SSH and Telnet to ensure secure communication.

Detailed contents:

Experiment 1: Installation of network security took like Wireshark and detailed study of its user interface.

Experiment 2: Capturing live network data.

Experiment 3: Study if different file formats for captured data. Opening, saving, merging of captured data.

Experiment 4: Explaining HTTP Traffic.

Experiment 5: Create a scenario for capturing PDU: Protocol Data UNIT.

Experiment 6: Tracking network activity(packet loss and packet discard, etc.).

Experiment 7: Write a program to implement Packet Sniffing

Experiment 8: To analyse and test packet for SSH and telnet

Course title	**Advanced Algorithms**
Course Code	**25C1ITP-201**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**UG level course in Algorithm Design and Analysis**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Analyze the complexity/performance of different algorithms
CO2	Determine the appropriate algorithms for solving a particular set of problems
CO3	Conclude necessary mathematical abstraction to solve problems
CO4	Categorize the different problems in various clauses according to their computation difficulties
CO5	Discuss recent activities in the field of the advanced data structure.

Detailed contents:

UNIT 1: (6 hours)
Sorting: Review of various sorting algorithms, topological sorting
Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

UNIT 2: (8 Hours)
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.
Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

UNIT 3: (9 hours)

Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

UNIT 4: (10 hours)

Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming.

Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem.

Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm.

UNIT 5: (10 hours)

Linear Programming: Geometry of the feasibility region and Simplex algorithm.

NP-completeness: Examples, proof of NP-hardness and NP-completeness.

One or more of the following topics based on time and interest

Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

UNIT 6:(5 hours)

Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

Suggested Readings/Books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

Course title	**Soft Computing**
Course Code	**25C1ITP-202**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Basic knowledge of mathematics**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Infer the concepts of soft computing techniques and identify their roles in building intelligent machines.
CO2	Implement fuzzy logic and neural based methods to handle uncertainty and solve various engineering problems.
CO3	Apply genetic algorithms to combinatorial optimization problems.
CO4	Implement different methods using tools and libraries.
CO5	Evaluate recent trends of machine learning and deep learning algorithms with its application.

Detailed contents:

UNIT 1: 7 Hours
Introduction To Soft Computing And Neural Networks: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics.

UNIT 2: 8 Hours
Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

UNIT 3: 10 Hours

Neural Networks: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

UNIT 4: 5 Hours

Genetic Algorithms: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition.

UNIT 5: 13 Hours

Matlab/Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.

UNIT 6:5 hours

Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

Suggested Readings/Books:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing17, Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications17, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Course title	**Big Data Analysis**
Course Code	**25C1ITP-PE3-01**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Data Structure, Computer Architecture and Organization**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Describe big data concepts, use cases, and applications across various industries.
CO2	Explain NoSQL databases and their role in big data management.
CO3	Install, configure, and run Hadoop and HDFS to process and manage large datasets.
CO4	Perform MapReduce analytics using Hadoop and understand its architecture and execution flow.
CO5	Use Hadoop-related tools such as HBase, Cassandra, Pig, and Hive to perform big data analytics.

Detailed contents:

UNIT 1: 8 Hours

What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and Big data, risk and big data, credit risk management, big data and algorithmic trading, big data and health care, big data in medicine, advertising and big data, Big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and Trans firewall analytics.

UNIT 2: 8 Hours

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases,schema less databases, Materializedviews, distribution models, sharding, master-slave replication, peer- peer replication, sharding and replication, consistency, relaxing consistency, Version stamps, mapreduce, partitioning and combining, composing map-reduce Calculations.

UNIT 3: 9 Hours

Communications via Network and the Web: State Machine, Correct Communications Model, Android Data format, analysing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts,Java Interface, dataflow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

UNIT 4: 10 Hours

MapReduce workflows, UNIT tests with MR UNIT, test data and local tests, anatomy of Map Reduce job run, classic Map-reduce,YARN,failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats

UNIT 5: 7 Hours

Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra datamodel, Cassandra examples, Cassandra clients, Hadoop Integration.

UNIT 6: 6 hours

Pig, Grunt, pig data model, PigLatin, developing and testing Pig Latin Scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Suggested Readings/Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. P.J.Sadalage and M.Fowler, "No SQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" ,Addison - Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
5. E.Capriolo, D.Wampler, and J.Rutherglen, "Programming Hive", O'Reilley, 2012.
6. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
7. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
8. Alan Gates, "Programming Pig", O'Reilley, 2011.

Course title	**Cloud Computing**
Course Code	**25C1ITP-PE3-02**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Linux- based Operating System**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Identify security aspects of each cloud model and their impact on cloud services.
CO2	Develop a risk-management strategy for moving to the cloud, considering security, compliance, and privacy factors.
CO3	Implement a public cloud instance using a public cloud provider (e.g., AWS, Azure).
CO4	Apply trust-based security models to different layers of cloud computing environments, including IaaS, PaaS, and SaaS.
CO5	Evaluate governance, risk, and compliance (GRC) frameworks in the context of cloud security and auditing.

Detailed contents:
UNIT 1: 4 Hours
Introduction to CloudComputing
Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks,Novel Applications Of Cloud Computing

UNIT 2: 11 Hours
Cloud Computing Architecture
Requirements, Introduction Cloud Computing architecture, On Demand Computing Virtualization At The Infrastructure Level, SecurityinCloud computing environments, CPU Virtualization, A discussion Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing,The Traditional Software Model, The Cloud Services Delivery Model

Cloud Deployment Models Key Drivers to Adopting the Cloud, The Impact of Cloud Computing Users, Governance in Cloud, Barriers to Cloud Computing Adoption in the Enterprise.

UNIT 3: 10 Hours
Security Issues in Cloud Computing
Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security And Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security.
Identity and Access Management Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards And Protocols for Cloud Services, I'M Practices in the Cloud, Cloud Authorization Management

UNIT 4: 11 Hours
Security Management in Cloud
Security Management Standards, Security Management in Cloud, Availability Management: SaaS, PaaS, IaaS
Privacy Issues
Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance In Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations.

UNIT 5: 8 Hours
Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance(GRC), Regulatory/ External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud

UNIT 6:4 hours
ADVANCED TOPICS
Recent developments in hybrid cloud and cloud security.

Suggested Readings/Books:

1. Cloud Computing Explained: Implementation Handbook for Enterprises,
2. John Rhoton, Publication Date:November 2,2009
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'ReillyMedia, September 2009

Course title	**Intrusion Detection**
Course Code	**25C1ITP-PE3-03**
Scheme and Credits	**L T P C Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Computer Networks, Computer Programming**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Apply knowledge of IDS fundamentals to avoid pitfalls in IDS creation and evaluation.
CO2	Evaluate enterprise security and apply IDS tools to enhance security posture.
CO3	Identify and describe various types of IDS technologies.
CO4	Define emerging IDS technologies and assess their effectiveness.
CO5	Design IDS-based security strategies to mitigate modern threats.

Detailed contents:

UNIT 1: 10 Hours

The state of threats against computers, and networked systems- Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN-Overview of Intrusion Detection and Intrusion Prevention- Network and Host-based IDS

UNIT 2: 8 Hours

Classes of attacks- Network layer: scans, denial of service, penetration- Application layer: software exploits, code injection- Human layer: identity theft, root access- Classes of attackers- Kids/ hackers/ sop Hesitated groups- Automated: Drones, Worms, Viruses

UNIT 3: 8 Hours

A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS

UNIT 4: 10 Hours

Anomaly Detection Systems and Algorithms- Network Behavior Based Anomaly Detectors(rate based)- Host-based Anomaly Detectors- Software Vulnerabilities- State transition, Immunology, Payload Anomaly Detection.

UNIT 5: 8 Hours

Attack trees and Correlation of alerts- Autopsy of Worms and Botnets-Malware Detection-Obfuscation, polymorphism-Document vectors

UNIT 6: 4 hours

Email/ IM security issues- Viruses/ Spam- From signatures to thumb prints to zero- day detection - Insider Threat issues- Taxonomy- Masquerade and Impersonation- Traitors, Decoys and Deception- Future: Collaborative Security.

Suggested Readings/Books:

1. The Art of Computer Virus Research and Defense, Peter Szor, Symantec Press ISBN0-321- 30545-3
2. Crimeware, Understanding New Attacks and Defenses, MarkusJakobsson and Zulfikar Ramzan, Symantec Press, ISBN:978-0-321-50195-02008

Course title	**Data Visualization**
Course Code	**25C1ITP-PE4-01**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Computer Graphics, Image Processing**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Analyze the design process for developing visualization methods and systems, applying evaluation techniques.
CO2	Implement data preparation, visual mapping, and effective data visualization strategies for various datasets.
CO3	Interpret and apply visualization techniques to represent large-scale and abstract data.
CO4	Evaluate and apply appropriate classification techniques in visualizing one, two, and multi-dimensional data.
CO5	Develop and assess the effectiveness of various visualization techniques, including those for geographic data, networks, and volumetric data.

Detailed contents:

UNIT 1: 8 Hours
Introduction of visual perception, visual representation of data, Gestalt principles, Information overloads.

UNIT 2: 8 Hours
Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT 3: 10 Hours
Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT 4: 11 Hours
Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

UNIT 5: 7 Hours
Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GISsystems, collaborative visualizations, Evaluating visualizations.

UNIT 6: 4 hours
Recent trends in various perception techniques, various visualization techniques, Data structures used in data visualization.

Suggested Readings/Books:

1. WARD, GRINSTEIN, KEIM, Interactive Data Visualization: Foundations, Techniques, andApplications. Natick: AK Peters, Ltd.
2. E.Tufte, The Visual Display of Quantitative Information, Graphics Press.

Course title	**Machine Learning**
Course Code	**25C1ITP-PE4-02**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Probability and Statistics, Linear Algebra**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Identify the basics of learning problems with hypothesis and version spaces.
CO2	Apply the features of machine learning in real-world problems.
CO3	Analyze the machine learning algorithms as supervised and unsupervised learning approaches.
CO4	Analyze the concept of neural networks for learning linear and non-linear activation functions.
CO5	Elaborate the concepts in Bayesian analysis from probability models and methods.
CO6	Design various Genetic Algorithms for the optimization of engineering problems.

Detailed contents:

UNIT 1: 10 Hours

Supervised Learning (Regression/Classification): Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

UNIT 2: 7 Hours

Unsupervised Learning: Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)

UNIT 3: 6 Hours

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, RandomForests).

UNIT 4: 9 Hours

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning.

UNIT 5: 9 Hours

Scalable Machine Learning (Online and Distributed Learning): A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference.

UNIT 6: 5 hours

Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

Suggested Readings/Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Course title	**Wireless Sensor Network**
Course Code	**25C1ITP-PE4-03**
Scheme and Credits	**L T P C** **Semester – II** **3 0 0 3**
Pre-requisite (if any)	**Wireless Communication**
Internal Marks	**40**
External Marks	**60**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Design sensor networks for various applications, considering network architecture, hardware platforms, and performance metrics.
CO2	Develop and implement data dissemination protocols, evaluating their efficiency and modeling link costs for optimal performance.
CO3	Analyze the fundamental concepts of wireless sensor networks, including protocol structures across different layers.
CO4	Evaluate and assess the performance of wireless sensor networks, identifying potential bottlenecks and areas for improvement.
CO5	Implement and assess various routing protocols for wireless sensor networks, including MANET protocols, data-centric routing, and opportunistic routing.

Detailed contents:

UNIT 1: 9 Hours
Introduction to Wireless Sensor Networks: Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors
Network Architecture: Traditional layered stack, Cross-layer designs, Sensor Network Architecture **Hardware Platforms:** Motes, Hardware parameters

UNIT 2: 9 Hours
Introduction to ns-3: Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.

UNIT 3: 8 Hours
Medium Access Control Protocol design: Fixed Access, Random Access, WSN protocols: synchronized, duty-cycled.
Introduction to Markov Chain: Discrete time Markov Chain definition, properties, classification and analysis.
MAC Protocol Analysis: Asynchronous duty-cycled. X-MAC Analysis (Markov Chain).

UNIT 4: 8 Hours
Security: Possible attacks, countermeasures, SPINS, Static and dynamic key distribution.

UNIT 5: 10 Hours
Routing protocols: Introduction, MANET protocols
Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast
Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain) Advanced topics in wireless sensor networks.

UNIT 6: 4 hours
Advanced Topics: Recent development in WSN standards, software applications.

Suggested Readings/Books:
1. W. Dargie and C. Poellabauer, “Fundamentals of Wireless Sensor Networks –Theory and Practice”, Wiley 2010
2. KazemSohraby, Daniel Minoli and TaiebZnati, “wireless sensor networks -Technology, Protocols, and Applications”, Wiley Interscience 2007
3. Takahiro Hara,Vladimir I. Zadorozhny, and Erik Buchmann, “Wireless Sensor Network Technologies for the Information Explosion Era”, springer 2010

Course title	**Advanced Algorithms Lab**
Course Code	**25C1ITP-211**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Implement Dijkstra's algorithm for single-source shortest path in a weighted directed graph.
CO2	Determine all-pairs shortest path using the Floyd-Warshall algorithm.
CO3	Formulate the inverse of a triangular matrix using a divide and conquer strategy.
CO4	Compute modulo representation from base (decimal/hexa) representation.
CO5	Design FFT.

Detailed contents:

Experiment 1: WAP to implement Dijkstra's algorithm for single-source shortest path in a weighted directed graph

Experiment 2: WAP to find all-pairs shortest path using Floyd-Warshall algorithm.

Experiment 3: WAP to find the inverse of a triangular matrix using divide and conquer strategy.

Experiment 4: WAP to convert base (decimal/hexa) representation to modulo representation

Experiment 5: WAP to implement FFT

Course title	**Soft Computing Lab**
Course Code	**25C1ITP-211**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:
At the end of this course, students will be able to

CO1	Inspect and apply basic array and string operations using Python functions.
CO2	Identify and use Python libraries to develop simple neural network models.
CO3	Interpret fuzzy logic concepts using standard toolbox functions.
CO4	Implement operations on fuzzy sets to address uncertainty in problem-solving.
CO5	Design and demonstrate a mini-project using neural or fuzzy-based techniques relevant to real-world engineering problems.

Detailed contents:

Experiment 1: WAP to implement array operations in Python

Experiment 2: WAP to append strings using functions in Python

Experiment 3: Study of Neural Network Tool Box/ use of Library functions

Experiment 4: Study of Fuzzy Logic Tool Box/ use of Library functions

Experiment 5: WAP to perform operations on fuzzy sets.

Experiment 6: Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Big Data Analysis Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Set up a single-node Hadoop cluster backed by HDFS on Ubuntu Linux.
CO2	Construct a multi-node Hadoop cluster with one master and multiple slave nodes.
CO3	Create and run a MapReduce application for word counting on a Hadoop cluster.
CO4	Implement NoSQL on Hadoop, and perform operations such as NoSQL queries using the API.
CO5	Utilize the Mahout machine learning library to facilitate big data analysis and knowledge building

Detailed contents:

Experiment 1: Set up a single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux.

Experiment 2: Configuration of a multi-node Hadoop cluster (one master and multiple slaves).

Experiment 3: MapReduce application for word counting on Hadoop cluster

Experiment 4: Unstructured data into NoSQL data and do all operations such as NoSQL query with API.

Experiment 5: Mahout machine learning library to facilitate the knowledge build up in big data analysis.

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Cloud Computing Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Execute basic scheduling algorithms for load balancing in cloud-based simulators.
CO2	Demonstrate the functionality of Microsoft Azure by creating storage accounts, deploying Virtual Machines, and setting up SQL servers.
CO3	Implement virtualization using VMware or Oracle's VirtualBox.
CO4	Test Hadoop for setting up a distributed data processing system.
CO5	Analyze and present a case study on Amazon Web Services (AWS) to understand cloud service offerings.

Detailed contents:

Experiment 1: Study and demonstration of Eucalyptus or Open Nebula or equivalent to set up the cloud.

Experiment 2: Implementation of virtualization using VM Ware's workstation/Oracle's Virtual Box

Experiment 3: Installation and Configuration of Hadoop.

Experiment 4: Implementing basic scheduling algorithms for load balancing in cloud based simulators.

Experiment 5: Working with Microsoft Azure: Creating storage account, creating deploying Virtual Machine, and cloud service, Setting up SQL server or any other database server..

Experiment 6: Case Study: Amazon Web Services

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Intrusion Detection Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Install SNORT on the operating system of your choice.
CO2	Create new SNORT rules for detecting specific network threats.
CO3	Implement basic Intrusion Detection using SNORT.
CO4	Analyze network traffic using SNORT for detecting malicious activities.
CO5	Test SNORT in a pfSense environment for Intrusion Detection

Detailed contents:

Experiment 1: Installation and configuration of snort: A signature-based Intrusion Detection System on the OS of your choice.

Experiment 2: IDS testing using SNORT, like Ping.

Experiment 3: Creating SNORT rules

Experiment 4: Configuring SNORT in pfsense to setup Intrusion Detection system.

Experiment 5: Network packet analysis using SNORT.

Experiment 6: Malicious Traffic Detection with Snort.

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Data Visualization Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Describe the fundamental concepts of R programming and its environment for data visualization.
CO2	Construct various types of graphs such as scatter plots, histograms, and bar charts using R.
CO3	Visualize multi-dimensional datasets using appropriate R libraries and tools.
CO4	Implement spatial and geographic information system (GIS) data visualization in R.
CO5	Analyze clusters and classification results using k-means and decision trees in R.

Detailed contents:

Experiment 1: Take data set of retail industry or any other field of your choice and create the following in R:
Scatter Plot
Histogram
Bar & Stack Bar Chart

Experiment 2: Write a program in R to visualize 2 or more dimensional data. You can use a visualization tool of your choice.

Experiment 3: Write a program in R to implement visualization of data points on a map.
Experiment 4: Write a program in R to implement k-means for cluster visualization.

Experiment 5: Explain the process of creating trees in R. Draw a tree either using programming or from a file.

Experiment 6: Explain visualization of spatial data in R or implementation of GIS in R. Create an application for the same.

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Machine Learning Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Make use of the various machine learning tools
CO2	Implement and analyse the procedures for supervised and unsupervised learning
CO3	Design and implement Python programs to solve real time problems
CO4	Apply appropriate datasets to implement SVM classification and analyse them through graphical outcomes.
CO5	Apply and implement learned algorithms design techniques in a project to get exposure to solve problems

Detailed contents:

Experiment 1: Study of platform for Implementation of Assignments
Download the open source software of interest. Document the distinct features and functionality of the software platform. You may choose WEKA, R or any other software..

Experiment 2: Supervised Learning - Regression
Generate a proper 2-D data set of N points.
Split the data set into Training Data set and Test Data set.

i) Perform linear regression analysis with Least Squares Method.
ii) Plot the graphs for Training MSE and Test MSE and comment on Curve Fitting and Generalization Error.
iii) Verify the Effect of Data Set Size and Bias-Variance Trade off.

iv) Apply Cross Validation and plot the graphs for errors.
v) Apply Subset Selection Method and plot the graphs for errors.
Describe your findings in each case..

Experiment 3: Supervised Learning - Classification
Implement Naïve Bayes Classifier and K-Nearest Neighbour Classifier on Data set of your choice. Test and Compare for Accuracy and Precision.

Experiment 4: Unsupervised Learning
Implement K-Means Clustering and Hierarchical clustering on proper data set of your choice. Compare their Convergence.

Experiment 5: Dimensionality Reduction
Principal Component Analysis-Finding Principal Components, Variance and Standard Deviation calculations of principal components.

Experiment 6: Supervised Learning and Kernel Methods
Design, Implement SVM for classification with proper data set of your choice. Comment on Design and Implementation for Linearly non-separable Dataset.

Experiment 7: Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.

Course title	**Lab Based on Electives III and IV** **2 hours for Lab based on Elective I and 2 hours for Lab based on Elective II**
Program Elective Subject	**Wireless Sensor Network Lab**
Course Code	**25C1ITP-212**
Scheme and Credits	**L T P C** **Semester – II** **0 0 4 2**
Pre-requisite (if any)	
Internal Marks	**60**
External Marks	**40**
Total Marks	**100**

Course Outcomes:

At the end of this course, students will be able to

CO1	Explain various network simulators used for Wireless Sensor Networks (WSNs)
CO2	Apply basic TCL scripting to configure a simulation scenario using network simulators.
CO3	Analyze various simulation models and evaluate their effectiveness based on simulation parameters.
CO4	Evaluate the performance of different routing protocols using performance metrics like energy consumption, latency, and packet delivery.
CO5	Create a functional mini-project using WSN simulation tools that demonstrates understanding of key course concepts.

Detailed contents:

Experiment 1: Introduction to Network Simulators used for Wireless Sensor Networks

Experiment 2: Introduction to TCL scripting: Demonstration of one small network simulator setup

Experiment 3: To study various trace files formats of Network Simulators.

Experiment 4: To create a sensor network setup using the nodes configured with fixed initial energy, transmission power, reception power, routing agent, transport agent and application in a rectangular area.

Experiment 5: Create different simulation scenarios by varying MAC protocols.

Experiment 6: Compute the performance of the above created simulation scenarios of the network in terms of total energy consumption, transmission latency, number of packets generated, received and dropped.

Experiment 7: To implement and compare various routing protocols using above mentioned performance metrics.

Experiment 8: Mini Project: Student has to do a project assigned from course contents in a group of two or three students. The team will have to demonstrate as well as have to give a presentation of the same.