MALLA REDDY UNIVERSITY

I Year M. Tech – I Semester **L / T /P / C**

3 / 0 / 2 / 4

(MR25-2PG0113) ADVANCED COMPUTER NETWORKS

COURSE OBJECTIVES:

1. To understand the principles and protocols of wired and wireless data communication, routing, and congestion control in modern networks.
2. To study transport and application layer protocols that enable reliable communication and efficient data transfer across networks.
3. To learn the working principles of web-based communication, file transfer, and network programming using standard internet protocols.
4. To understand the concepts, technologies, and management principles of wireless and mobile communication networks.
5. To study the concepts and protocols that support real-time and multimedia communication over networks.

UNIT – I:

Data-link protocols: Ethernet, Token Ring and Wireless (802.11). Wireless Networks and Mobile IP: Infrastructure of Wireless Networks, Wireless LAN Technologies, IEEE 802.11 Wireless Standard, Cellular Networks, Mobile IP, Wireless Mesh Networks (WMNs), Multiple access schemes Routing and Internetworking: Network–Layer Routing, Least-Cost-Path algorithms, Non-Least-Cost-Path algorithms, Intra-domain Routing Protocols, Inter-domain Routing Protocols, Congestion Control at Network Layer.

UNIT – II:

Transport and Application Layer Protocols: Protocols on the transport layer, reliable communication. Routing packets through a LAN and WAN. Transport Layer, Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Mobile Transport Protocols, TCP Congestion Control. Principles of Network Application. Application Layer Protocols: HTTP, SMTP, and DNS.

UNIT – III:

The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, Domain Name System (DNS), P2P File Sharing, Socket Programming with TCP and UDP, building a Simple Web Server Creating simulated networks and passing packets through them using different routing techniques. Installing and using network monitoring tools.

UNIT –IV:

Wireless and Mobile Networks: Introduction, Wireless links and Network Characteristics - CDMA, Wifi: 802.11 Wireless LANS, Cellular internet access, Mobility management: Principles

UNIT – V:

Multimedia networking: Multimedia networking applications, streaming stored video, Voice-over-IP, Protocols for real-time conversational applications.

REFERENCE BOOKS:

1. Computer Networking: A Top-Down Approach, James F. Kuros and Keith W. Ross, Pearson, 6th Edition, 2012.
2. Computer Networks and Internets, Duglas E. Comer, 6th Edition, Pearson.
3. A Practical Guide to Advanced Networking, Jeffrey S. Beasley and Piyasat Nilkaew, Pearson, 3rd Edition, 2012
4. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Prentice Hall.

COURSE OUTCOMES:

1. Students will be able to analyze and implement network-layer routing and wireless communication protocols for efficient data transmission.
2. Students will be able to design and evaluate network applications using transport layer protocols like TCP, UDP, and mobile transport mechanisms.
3. Students will be able to implement and analyze web, email, and file transfer applications using TCP/UDP sockets and network monitoring tools.
4. Students will be able to explain and analyze wireless network architectures, mobility management, and communication protocols like CDMA and Wi-Fi.
5. Students will be able to design and evaluate multimedia applications such as video streaming and Voice-over-IP using appropriate networking protocols.

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I Year M. Tech – I Semester **L / T /P / C**

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(MR25-2PG0114) GOOGLE CLOUD COMPUTING

COURSE OBJECTIVES:

1. To introduce the fundamental concepts, architecture, and service models of cloud computing along with its advantages and challenges.
2. To familiarize students with the fundamental concepts, structure, and management tools of Google Cloud Platform.
3. To provide knowledge of GCP compute and storage services for deploying applications and managing data efficiently.
4. To understand the networking, security, and management components of Google Cloud Platform for building secure and scalable cloud infrastructures.
5. To explore GCP tools for data analytics, artificial intelligence, and DevOps automation in cloud environments.

UNIT -I:

Introduction to Cloud Computing: Definition of Cloud Computing, Traditional vs cloud computing, basic roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers, Challenges and Risks.

UNIT -II:

Introduction Google Cloud Platform: Introduction to Google Cloud Platform (GCP), GCP regions, zones, projects, and resource hierarchy. GCP Console and Cloud SDK (Google cloud tool), Identity and Access Management (IAM) basics. Overview of billing, pricing, and cost management.

UNIT - III:

Compute and Storage Services:

Compute Services: Compute Engine: Virtual Machines, images, snapshots, App Engine and Cloud Run: Deploying applications, Kubernetes Engine (GKE): Managing containerized workloads.

Storage Services: Cloud Storage: Buckets, lifecycle management, Persistent Disks, Filestore, and Archive storage, Overview of Cloud SQL, Cloud Spanner, Bigtable, and Firestore

UNIT - IV:

Networking, Security, and Management: Virtual Private Cloud (VPC) architecture, Subnets, IP addressing, and firewall rules, Load balancing, Cloud CDN, DNS, VPN, and Interconnect, Identity and Access Management (IAM) roles and policies, Resource and security management best practices,

Operations Suite (Stack driver): Monitoring, Logging, and Alerts, Deployment Manager and automation tools

UNIT -V:

Data Analytics, AI, and DevOps Tools: BigQuery: Data warehousing and analytics, Dataflow, Dataproc, and Pub/Sub for data processing, Vertex AI: End-to-end machine learning workflows, AI APIs: Vision, Translation, Speech, Natural Language, DevOps and CI/CD on GCP using Cloud Build and Artifact Registry, Overview of Cloud Source Repositories and pipeline automation

REFERENCE BOOKS:

1. Mastering Cloud Computing, Foundations and Applications Programming- Raj Kumar Buyya, Christian Vecchiola and S.TamaraiSelvi, MK publications, 2012.
2. Google Cloud Platform in Action, JJ Geewax, Manning Publications, 1st Edition, 2017.
3. Google Cloud Platform All-In-One Guide, Praveen Kukreti, BPB Publications, 1st Edition, 2023.
4. Google Cloud Platform for Developers: Build highly scalable applications on the Google Cloud Platform, Ted Hunter & Steven Porter, Packt Publishing, 1st Edition, 2018.
5. Google Cloud Platform – Networking: Beginner to Skilled Practitioner in One Book, Alasdair Gilchrist, Independently Published, 1st Edition, 2019.

COURSE OUTCOMES:

1. Students will be able to explain the key features, types, and service models of cloud computing and identify its challenges and risks.
2. Students will be able to navigate the GCP environment, manage resources, and understand IAM, billing, and cost management principles.
3. Students will be able to deploy and manage virtual machines, containers, and cloud storage solutions using various GCP services.
4. Students will be able to configure VPC networks, implement security controls, and manage resources using GCP monitoring and automation tools.
5. Students will be able to analyze data, build AI models, and implement CI/CD pipelines using various GCP services and tools.

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I Year M. Tech – I Semester **L / T /P / C**
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(MR25-2CS0041) ADVANCED DATA STRUCTURES

Prerequisites:

Data Structures, Algorithm Analysis, Programming in C/C++ or Java

COURSE OBJECTIVES:

1. Understand the advanced hashing techniques and their applications in real-world problems.
2. Be able to apply priority queue structures to solve scheduling and optimization problems.
3. Be able to apply advanced tree structures for efficient searching and retrieval operations.
4. Be able to apply graph algorithms to solve shortest path and network flow problems.
5. Be able to deploy string matching algorithms in pattern recognition and text processing applications.

Unit I: Hashing and Skip Lists

Hashing Fundamentals: General idea of hashing, Hash functions and their properties, Collision resolution techniques, Separate chaining with linked lists, Open addressing methods: Linear probing, Quadratic probing, Double hashing, Load factor and performance analysis, Rehashing and dynamic resizing, Universal hashing concepts, Perfect hashing, Extendible hashing for dynamic files, Applications of hashing in databases and compilers.

Skip Lists: Probabilistic data structure fundamentals, Skip list representation and structure, Randomized level generation, Search operations in skip lists, Insertion operations with level assignment, Deletion operations and pointer updates, Time complexity analysis: Expected O(log n), Space complexity considerations, Comparison with balanced trees, Applications in concurrent data structures.

Case Study: Implementing a High-Performance Cache System Using Advanced Hashing Techniques

Unit II: Priority Queues and Heap Structures

Binary Heaps: Introduction to priority queues, Heap property: Min-heap and max-heap, Complete binary tree representation, Array representation of heaps, Basic heap operations: Insert, DeleteMin, BuildHeap, Heapify operation and its complexity, Heap sort algorithm, Applications in scheduling algorithms.

Binomial Heaps: Binomial tree properties, Binomial heap structure, Union operation for binomial heaps,

Insert operation using union, FindMin operation, DeleteMin operation, DecreaseKey operation, Delete operation, Time complexity analysis, Comparison with binary heaps.

Fibonacci Heaps: Structure and properties, Lazy consolidation approach, Amortized analysis, Decrease key in O(1) amortized time, Applications in Dijkstra's and Prim's algorithms.

Leftist Heaps and Skew Heaps: Null path length concept, Leftist property, Merge operation, Applications in mergeable heaps. **[Reference 1&2]**

Case Study: CPU Scheduling and Task Management Using Priority Queue Implementations

UNIT III: Advanced Binary Search Trees

AVL Trees: Balance factor and height property, Single rotations: Left rotation and right rotation, Double rotations: Left-Right and Right-Left rotations, Insertion with balancing, Deletion with balancing, Time complexity: O(log n) guarantee, Height analysis and proof of balance.

Splay Trees: Self-adjusting binary search trees, Splaying operation, Zig, Zig-Zig, and Zig-Zag cases, Top-down splaying, Amortized analysis, Applications in caching.

Red-Black Trees: Red-Black properties and invariants, Color constraints and height balance, Insertion algorithm with recoloring and rotations, Deletion algorithm with fixup operations, Comparison with AVL trees, Applications in language libraries (C++ STL, Java TreeMap).

B-Trees: Motivation for B-Trees in external storage, B-Tree properties and order, Search operation in B-Trees, Insertion with node splitting, Deletion with key redistribution and merging, B+ Trees and their advantages, Applications in database indexing and file systems.

2-3 Trees: Node types and properties, Search, insertion, and split operations, Relationship with B-Trees.

Case study: Database Indexing Optimization Using B-Trees: A Performance Analysis Study

UNIT IV: Disjoint Sets and Graph Algorithms

Disjoint Sets (Union-Find): Equivalence relations and equivalence classes, Basic data structure: Parent array representation, Union operation: Union by size and union by rank, Find operation: Path compression optimization, Inverse Ackermann function complexity, Applications: Kruskal's MST algorithm, Connected components, Cycle detection.

Graph Algorithms - Elementary Operations: Graph representations: Adjacency matrix and adjacency list, Breadth-First Search (BFS) traversal, Depth-First Search (DFS) traversal, Topological sorting using DFS, Applications of topological sort.

Shortest Path Algorithms: Single-source shortest path problem, Dijkstra's algorithm using priority queues, Time complexity analysis with different heap implementations, Bellman-Ford algorithm for negative edge weights, Detection of negative cycles, All-pairs shortest paths problem, Floyd-Warshall algorithm using dynamic programming, Transitive closure computation.

Network Flow: Flow networks and properties, Maximum flow problem, Ford-Fulkerson method, Edmonds-Karp algorithm, Applications: Bipartite matching, Maximum bipartite matching.

Case Study: Route Optimization in Transportation Networks Using Graph Algorithms: A Real-World Application

UNIT V: String Matching and Digital Search Structures

String Matching Algorithms: String matching problem definition, Naive string-matching algorithm: Brute force approach, Time complexity O(nm), Rabin-Karp algorithm: Rolling hash technique, Spurious hits handling, Average and worst-case analysis, Knuth-Morris-Pratt (KMP) algorithm: Prefix function computation, Failure function and automaton approach, Time complexity O(n+m), Boyer-Moore algorithm concepts, Applications in text editors and search engines.

Digital Search Structures: Trie fundamentals and motivation, Standard trie structure, Operations: Search, insertion, deletion, Space optimization considerations, Compressed tries concept.

Binary Tries: Binary trie structure, Bit-wise comparison, Search and insertion operations.

Patricia (Practical Algorithm to Retrieve Information Coded in Alphanumeric): Compressed binary trie structure, Skip counting optimization, Search operation with bit checking, Insertion with node creation, Deletion with node merging, Space efficiency analysis, Applications in IP routing tables.

Suffix Trees and Suffix Arrays: Introduction to suffix structures, Applications in pattern matching, Text compression applications.

Case Study: Text Search Engine Implementation Using Advanced String Matching: A Case Study in Information Retrieval

REFERENCE TEXTBOOKS:

1. "Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss, Pearson, Fourth Edition, 2014
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, The MIT Press, Third Edition, 2009
3. "Advanced Data Structures" by Peter Brass, Cambridge University Press, 2008
4. "Advanced Data Structures" by Reema Thareja, S. Rama Sree, Oxford University Press, 2018

5. "Data Structures and Algorithms Made Easy" by Narasimha Karumanchi, CareerMonk Publications, 2020

COURSE OUTCOMES:

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

1. Explain the principles of advanced hashing techniques and implement skip lists for efficient data retrieval.
2. Implement various heap structures (binary, binomial, Fibonacci) and apply them in priority queue applications.
3. Implement advanced balanced tree structures (AVL, Red-Black, B-Trees) and analyze their performance characteristics.
4. Implement disjoint set operations and apply graph algorithms for shortest path and network flow problems.
5. Deploy string matching algorithms and digital search structures for pattern recognition and text processing applications.

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CBCS Pool **L / T /P / C**

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(MR23- 2CS0042) Full Stack Web Development Using React Js

COURSE OBJECTIVES:

1. To understand the fundamentals of full-stack development and the MERN stack.
2. To gain proficiency in building dynamic front-end applications using ReactJS.
3. To explore the back-end server environment and development with Node.js.
4. To implement efficient APIs and routing with Express.js for CRUD operations.
5. To master NoSQL database operations and management with MongoDB.

UNIT – I:

Introduction: Introduction to Full Stack, Front-end, Backend, Databases, Web Design and development basics, Popular Stacks, what is MERN, MERN components, Tools and Libraries for Mongodb, ExpressJs, ReactJs and NodeJS

UNIT – II:

ReactJS: Introduction to React, , React JSX, React Components, React State, React Props, React Constructor, Component Life Cycle, React Forms, React Events, Conditional Rendering, React Lists, React Keys, React Refs, React Fragments, React Router, React Hooks, React Redux, React Redux Example, React Portals, React Error Boundaries.

UNIT – III:

Node js: Node js Overview, NPM – Setup, Node.js runtime Environment, Node.js Console, Node.js Command Utilities, Node.js Modules, Node.js events, Node.js database access, Authenticate Users in Node.js

UNIT –IV:

Express js: Express.js Template, Express.js middleware, CRUD operations,Express.js Get, Express.js Post, Express.js Request, Express.js Routing, Express. Js File upload.

UNIT – V:

MongoDB: Understanding MongoDB and NoSQL, MongoDB Data Types, planning your Data Model, Building the Mongo DB Environment, Administering User Accounts, Configuring Access Control, Database update Operators, Adding Documents to a Collection, Updating Documents in a Collection, Deleting Documents from a Collection, Removing a

Single Document from a Collection.

REFERENCE BOOKS:

1. Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express, React, Node.js App by Greg Lim.
2. Pro MERN Stack:Full Stack Web App Development with Mongo,Express,React and Node by Vasan Subramanian.
3. MERN Quick Start Guide by Eddy Wilson Iriarte Koroliova

COURSE OUTCOMES

1. Demonstrate the ability to create and manage full-stack web applications.
2. Build interactive front-end components with ReactJS and its advanced features.
3. Implement server-side functionalities using Node.js.
4. Develop RESTful APIs and handle requests/responses using Express.js.
5. Design, manage, and secure databases with MongoDB for scalable applications.

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M.Tech CBCS POOL **L/T/P/C**
4/0/0/4

(MR25-2CS0043) CLOUD COMPUTING

COURSE OBJECTIVES:

1. Analyse the trade-offs between deploying applications in the cloud and over the local infrastructure. Compare the advantages and disadvantages of various cloud computing platforms.
2. Investigate how a global storage solution can be optimized so that it can be delivered successfully from the cloud
3. Evaluate information storage management design in a cloud environment and how it relates to the business objectives of an organization
4. Analyse how best to provide reliable access to information both locally and remotely using storage technologies
5. Critically appraise the opportunities and challenges of information management in complex business environments.

UNIT–I:

Definition, characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multitenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

UNIT–II:

Virtualization concepts, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features

UNIT–III:

Relational databases, Cloud file systems: GFS and HDFS, Bigtable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map Reduce.

UNIT–IV:

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security.

UNIT–V:

Issues in cloud computing Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware.

TEXT BOOKS:

1. Enterprise Cloud Computing by Gautam Shroff, Cambridge publication
2. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

REFERENCE BOOKS:

1. Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley -India
3. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication
4. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539],2010
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 200
6. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley Publication,2011
7. Tim Mather, SubraKumara swamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'ReillyMedia Inc, 2009

COURSE OUTCOMES:

1. Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google AppEngine.
2. Program data intensive parallel applications in the cloud.
3. Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
4. Identify security and privacy issues in cloud computing.
5. Solve a real-world problem using cloud computing through group collaboration.

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CBCS Pool **L / T /P / C**

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(MR23-2CS0044) DISTRIBUTED DATABASE SYSTEMS

COURSE OBJECTIVES:

1. Understand the fundamentals of distributed database systems (DDBS) and their architectures.
2. Explore design strategies and issues in distributed database design, including fragmentation and allocation.
3. Learn query processing techniques and optimization algorithms in distributed environments.
4. Study transaction management mechanisms and distributed concurrency control algorithms.
5. Analyze reliability concepts, fault tolerance, and parallelism in distributed and object-oriented database systems.

UNIT – I:

Introduction; Distributed Data Processing, Distributed Database System, Promises of DDBSs, Problem areas.
Distributed DBMS Architecture: Architectural Models for Distributed DBMS, DDMBS Architecture.
Distributed Database Design: Alternative Design Strategies, Distribution Design issues, Fragmentation, Allocation.

UNIT – II:

Query processing and decomposition: Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data.
Distributed query Optimization: Query optimization, centralized query optimization, distributed query optimization algorithms.

UNIT – III:

Transaction Management: Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms, deadlock Management.

UNIT –IV:

Distributed DBMS Reliability: Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols, site failures and network partitioning.

Parallel Database Systems: Parallel database system architectures, parallel data placement, parallel query processing, load balancing, database clusters.

UNIT – V:

Distributed object Database Management Systems: Fundamental object concepts and models, object distributed design, architectural issues, object management, distributed object storage, object query Processing.

REFERENCE BOOKS:

1. M. Tamer OZSU and Patuck Valduriez: Principles of Distributed Database Systems, Pearson Edn. Asia, 2001.
2. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases, McGraw Hill.
3. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom: "Database Systems: The Complete Book", Second Edition, Pearson International Edition.

COURSE OUTCOMES

1. Gain the ability to design and implement distributed database architectures.
2. Optimize distributed queries to improve system efficiency and performance.
3. Apply concurrency control and transaction management techniques to maintain data integrity.
4. Implement reliability protocols and fault-tolerant measures in distributed DBMS.
5. Develop object-oriented distributed database management systems with efficient query processing and storage techniques.

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Open Elective **L / T /P / C**
3 /0 / 0/ 3

(MR25-2OE0101) RESEARCH METHODOLOGY

COURSE OBJECTIVES:

1. Introduce research paper writing and induce paper publication skills.
2. Give the introduction to Intellectual Property Rights.

UNIT–I:

Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process, Validity and Reliability in Research, Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design.

UNIT–II:

Sampling Design: Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design, Measurement and Scaling Techniques: Errors in Measurement, Tests of Sound Measurement, Scaling and Scale Construction
'I'echniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation.

UNIT–III:

Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules. Professional Attitude and Goals, Concept of Excellence, Ethics in Science and Engineering, Some Famous Frauds in Science (Case Studies),Correlation and Regression Analysis, Method of Least Squares, Regression Vs. Correlation, Correlation Vs. Determination, Types of Correlation and Their Specific
Applications.

UNIT–IV:

Statistical Interference: Tests of Hypothesis, Parametric Vs. Non-Parametric Tests, Procedure for Testing Hypothesis, Use of Statistical Techniques for Testing Hypothesis, Sampling Distribution, Sampling Theorem Chi-Square Test, Analysis of Variance and Covariance, Multivariable Analysis.

UNIT–V:

Interpretation of Data and Report Writing, Layout of a Research Paper, Techniques of Interpretation. Making Scientific Presentation at Conferences and Popular Lectures to Semi Technical Audience, Participating in Public Debates on Scientific Issues.

REFERENCE BOOKS:

1. Research Methodology: Methods And Techniques - C. R. Kothari, 2nd Edition, New Age International Publishers.
2. Research Methodology And Statistical Tools - P. Narayana Reddy And G.V,R.K, Acharyulu, l" Edition, Excel Books, New Delhi.

COURSE OUTCOMES

1. Ability to distinguish research methods.
2. Ability to write and publish a technical research paper.
3. Ability to review papers effectively.