

School of Mobile Computing & Communication
Jadavpur University

SYLLABUS

M.Tech in Distributed and Mobile Computing

1st Semester

Departmental Basket

Paper 1: Computer Networking Protocols and Techniques

Computer Network Architecture: Layers, Services and Protocols, Design issues for the layers; Interfaces and Services, Connection-oriented and connectionless services; Applications and Layered Architecture: ISO-OSI Reference Model; Overview of TCP/IP Architecture; The Berkeley API; Application Protocols and TCP/IP utilities; Peer-to-Peer Protocols : Peer-to-Peer Protocols and Service Models; ARQ Protocols and Adaptation Function; Data-Link Controls – HDLC and PPP; Link Sharing using Packet Multiplexers; Medium Access Control Protocols.

Packet-Switching Protocols: Routing and Congestion Control Protocols – Interior & Exterior Routing Protocols.

TCP/IP Architecture: The Internet Protocols – IPv4 & IPv6, UDP & TCP, DHCP and Mobile IP; Internet Routing Protocols, Multicast Routing.

Broadband Technology and Services.

ATM Networks : Layers, QoS, ATM Adaptation Layers, Signalling and PNNI Routing.

Internetworking: Virtual Circuit and Datagram Subnets: Internet Control Protocols;

Internetworking Protocols; Tunneling; Fragmentation: Firewalls.

Security Protocols: Security and Cryptographic Algorithm.

Books :

1. Computer Network – Andres S. Tanenbaum.
2. Data and Computer Communications – William Stallings.
3. Communication Networks – Leon Garcia and Widjaja.
4. TCP/IP Illustrated – W.R. Stevens.
5. TCP/IP Protocol Suite – Behrouz A Forouzan.

Paper 2: Wireless Networks and Mobile Systems

Cellular Mobile Wireless Networks: Systems and Design Fundamentals, Propagation Models

Description of cellular system, Frequency Reuse, Cochannel and Adjacent channel interference, Propagation Models for Wireless Networks, Multipath Effects in Mobile Communication, Models for Multipath Reception

Evolution of Modern Mobile Wireless Communication System -
First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Wireless Local Area Networks (WLANs), Cellular –WLAN Integration, All-IP Network: Vision for 4G

GSM: Architecture and Protocols -
Air Interface, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multiframe, Control (Signaling) Channel Multiframe, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, GSM Protocols and Signaling, Location Update Procedure, Routing of a call to a Mobile Subscriber

2.5G Networks - The General Packet Radio Services: (GPRS) -
GPRS Networks Architecture, GPRS Interfaces and Reference Points, GPRS Logical Channel, GPRS Mobility Management Procedures, GPRS Attachment and Detachment Procedures, Session Management and PDP Context, Data Transfer Through GPRS Network and Rout, GPRS Location Management Procedures, GPRS Roaming, The IP Internetworking Model, GPRS Interfaces and Related Protocols, GPRS Applications

Overview of CDMA systems: IS-95 Networks

3G – The Universal Mobile Telecommunication System (UMTS) -
UMTS Network Architecture –Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS downlink transport and physical channels, UMTS uplink transport and physical channels UMTS Time Slots, UMTS Network Protocol Architecture, Mobility Management for UMTS Network

Overview Mobile Internet Protocol -
Basic Mobile IP, Mobile IP Type-MIPv4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Problems and Limitations of MIP, MIPv4 Route Optimization

Mobility Management Issues: Role of IP on Wireless Networks -
IP for GPRS and UMTS R99, Protocol Reference Model for UMTS PS domain, Packet-Switched Domain Protocol Stacks: Role of Interfaces, The GTP Tunnel, The Iu-PS Interface and Mobility Management, Packet routing and transport of user data in UMTS network, Configuring PDP Addresses on Mobile Stations, Mobility Management in Wireless Networks, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution, Accessing External PDN through GPRS/UMTS PS Domain, Transparent Access, Use of

Mobile IP for Non-transparent access, Dynamically accesses IP address from External Network

Cellular and WLAN Integration: Heterogeneous Network Architecture, Step towards 4G Networks -

Why Integration, Benefits of Integration, nternetworking Network Architecture: Point of Integration, Overview of UMTS Network, IEEE 802.11 Overview

Integration Architecture: Tight Coupling Integration, Loose Coupling Integration, Handoff in integrated network architecture

Paper 3: Mobile Ad-hoc Networks

Introductory concepts. Different models of operation. Various applications of MANET.

Destination-Sequenced Distance Vector protocol - overview, route advertisement, extending base station coverage. Properties of DSDV protocol.

Dynamic Source Routing protocol - overview and properties, DSR route discovery, route maintenance. Support for heterogeneous networks and mobile IP. Multicast routing with DSR.

Ad Hoc On-Demand Distance-Vector protocol - properties, unicast route establishment, multicast route establishment. Broadcast. Optimizations and Enhancements.

Link Reversal Routing - Gafni-Bertsekas algorithm, lightweight mobile routing algorithm. Temporally ordered routing algorithm.

Preserving battery life of mobile nodes - Associativity based routing, effects of beaconing on battery life.

Recent trends in MANET.

Interdisciplinary Basket

Paper 4: Programming Mobile Devices

Motivation and Programming Strategies

Memory Management - Design Patterns for Limited Memory, Memory Management in Mobile Java, Memory Management in example OS

Applications - Workflow for Application Development, Techniques for Composing Applications, Application Models in Mobile Java, Case study: Symbian OS Application Infrastructure

Dynamic Linking - Implementation Techniques, Implementing Plugins, Managing Memory Consumption Related to Dynamically Linked Libraries, Rules of Thumb for Using Dynamically Loaded Libraries, Mobile Java and Dynamic Linking

Concurrency - Infrastructure for Concurrent Programming, MIDP Java and Concurrency, Case study: Symbian OS and Concurrency

Resource Management - Resource-Related Concerns in Mobile Devices, MIDP Java.
Networking - MIDP Java and Web Services, Bluetooth Facilities with an example OS
Security - Secure Coding and Design, Infrastructure for Enabling Secured Execution, Security Features in MIDP Java, Case study: Symbian OS Security Features

Paper 5: Distributed Systems

Distributed Systems Models: Architectural models – Client-Server model, Thin Client, Mobile Devices. Software agents. Fundamental models – Interaction, Failure and Security models.

Interprocess Communication: API for Internet protocols. External data representation and Marshalling. Client-Server communication and Group communication.

Distributed Objects and Remote Invocation: Communication between distributed objects. Remote Procedure Call. Remote Object Invocation. Events and notification. Message- and Stream-oriented communication. Case study: CORBA and DCOM.

Distributed File Systems: File service architecture. Sun NFS. Recent advances.

Name Services: Basic principles of Name Services. Domain Name System. Directory and discovery services. Locating Mobile entities. Case studies.

Coordination and Agreement: Distributed Mutual Exclusion. Elections. Consensus and related problems. Clock Synchronization

Transactions and Concurrency Control: Fundamental principles. Transactions and nested transactions. Locks. Optimistic concurrency control. Timestamp ordering.

Distributed transactions – Flat and nested transactions. Atomic commit protocols. Concurrency control in distributed transactions. Distributed deadlocks. Transaction recovery.

Distributed Snapshot Global State Collection
Important Case Studies.

Resources:

1. Distributed Systems : Concepts and Design - George Coulouris, Jean Dollimore, and Tim Kindberg.
2. Introduction to Reliable Distributed Programming - Rachid Guerraoui and Louis Rodrigues, Springer-Verlag, Berlin, Germany, 2006.
3. Distributed Systems: Principles and Paradigms - Andrew Tanenbaum and Maarten

van Steen, Prentice Hall, 2007.

4. Elements of Distributed Computing - Vijay K. Garg, Wiley, 2002.

5. Research Papers

Paper 6:

(i) Distributed and Mobile Architecture

Hardware Architecture - Symmetric Multiprocessing , Distributed Shared Memory, Multicomputers

Software Architecture - Client server architecture , 3-tier architecture , N-tier architecture, Peer-to-peer

Cluster computing

Grid computing

Virtualisation and Cloud Computing

Recent trends in processor technologies - Superscalar processors, Multi-core processors, Embedded processors

Resources:

1. Research Papers

(ii) Object Oriented Systems

Object Oriented Programming Concepts, Object Oriented Design Fundamentals, Software Components, Design Patterns, Extreme Programming, Refactoring, Component technology, Object Oriented frameworks, Distributed Objects, Object Request Brokers, case studies.

	<u>Marks</u>
Laboratory	100
Assignment	100
Total (1st semester)	800
2nd Semester	

Departmental Basket

Paper 7: Wireless and Mobile Protocols

Overview of Mobile Internet Protocol: MIP

Mobile Internet Protocol version 6: MIPv6

TCP for Mobile Environments, Case study with example TCP protocols

Wireless Application Protocols: WAP – Architecture and Protocol Suite

Bluetooth – Architecture, Network, Protocols

Overview of Wireless LAN Protocols: WiFi

WiMAX – 802.16

Paper 8: Security in Wireless and Mobile Systems

Overview: Security - Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, Policy and relevant definitions

Authentication – Different techniques

Cryptography – Symmetric Key Cryptography, Asymmetric key Cryptography, Key management, Digital signatures, Certificate

Distributed Systems Security – Cipher techniques, Protection systems, Example protocols

Wireless and Mobile system security – Strategies, Routing security, Different schemes for MANET

Paper 9:

(i) Wireless Sensor Networks

Sensor networks overview: introduction, applications, design issues, requirements.

Sensor node architecture.

Network architecture: optimization goals, evaluation metrics, network design principles.

Sensor network operating systems and brief introduction to sensor network programming.

Network protocols: MAC protocols and energy efficiency.

Routing protocols: data centric, hierarchical, location-based, energy efficient routing etc.

Sensor deployment, scheduling and coverage issues, self configuration and topology control.

Querying, data collection and processing, collaborative information processing and group connectivity.

Target tracking, localization and identity management.

Power management.

Security and privacy.

Resources:

1. Research Papers

(ii) Distributed Software Architecture

Client-server, N-tier, peer-to-peer, and super-peer Architectures. Architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and interoperability issues, Web application architectures: Web Clients, Web Servers, Object Models,

Protocols with case studies.

Distributed and Mobile Middleware Systems with case studies.

Interdisciplinary Basket

Paper 10:

(i) Multimedia Technology and Communications

Source representation and compression techniques text, speech and audio, still-image and video; Graphics and animation; Multi-modal communication; Multimedia communication, video conferencing, video-on-demand broadcasting issues, traffic shaping and networking support; Transcoding; Multimedia OS and middleware; Synchronization & QoS; Multimedia servers, databases and content management; Multimedia information system and applications

(ii) Distributed Operating Systems

Introduction. Different types of computer networks, various communication protocols.

Message passing mechanism - desirable features. Synchronization and Buffering. Multidatagram messages. Process addressing, failure handling. Group Communication – various schemes. Case studies.

Remote Procedure Call - model, transparency. Stub generation techniques, RPC messages, marshalling of arguments and results, parameter passing semantics. Communication protocols for RPCs. Client-Server binding, exception handling in RPC. Security issues.

Synchronization - Event ordering, Mutual exclusion. Election algorithms. Deadlock – conditions and various detection algorithms.

Process Management - process migration, threads.

Resource Management - processor allocation, scheduling

Distributed File Systems - various file models, accessing models, sharing semantics, file caching schemes. File replication. Atomic transactions. Case studies.

Security - Cryptography, Authentication, Access Control, Digital Signatures. Case studies.

(iii) Embedded Systems

Introduction to Embedded Systems

Architecture of Embedded Systems - Hardware Architecture, Software Architecture, Communication Software, Development/Testing Tools

Programming for Embedded Systems

The Process of Embedded System Development - Design Trade offs, Hardware Software co-design, Implementation, Integration and Testing

Hardware Platforms

Communication Interfaces

Embedded/Real-time Operating Systems Concepts - Representative Embedded Systems, Programming in RT-Linux

Embedded Database Application

Mobile Java Applications

Embedded Software Development on 8051 Micro-controller Platform

DSP-based Embedded Systems - Implementation of Embedded Systems with VHDL, FPGA and CPLD

Embedded Systems Applications using Strong ARM Platform

Resources:

1. Embedded/Real-time Systems: Concepts, Design and Programming – Dr. K.V.K.K. Prasad, Dreamtech press.
2. Programming for Embedded Systems – Dreamtech Software team, Willey - dreamtech

(iv) Dependable Computing

Concepts of Fault, Failure, Reliability, Availability, Safety, and other relevant definitions
Fault Models, Types of failures

Fault tolerance – Different techniques like Redundancy

Fault Tolerance in Database Systems - Commit Protocol, Weighted Voting quorum consensus.

Byzantine Faults-Solutions with signed and unsigned messages.

Fault Recovery-Forward and Backward Error Recovery, Checkpointing and Rollback
Domino effect

Software fault tolerance - Recovery block, N-version Programming Real-time systems
and fault tolerance-meeting deadlines in the presence of faults.

Fault tolerance for mobile computing systems

(v) Power-aware Computing

Power management – Circuit level, Architecture level, Energy-exposed Instruction set

Operating System level Power management – Power-aware real-time system

Power-aware APIs for embedded and portable system

Compiler level Power management

Application level Power awareness and management

Power management in web servers

Resources:

1. Graybill, Robert; Melhem, Rami (Eds.), Power Aware Computing, , Series: Series in
Computer Science , 2002, 384 p., Hardcover, ISBN: 978-0-306-46786-8

	<u>Marks</u>
Seminar	100
Term Paper leading to Thesis	100
Total Marks (2nd semester)	600