Course Code	Name of the Course	L	T	P	C
	DATA COMMUNICATIONS AND NETWORKING	3	0	2	3

About the Course

Data Communications and Networking covers principles, protocols and practices that enable reliable exchange of information over networks. The course builds conceptual understanding of layered protocol architectures (OSI/TCP-IP), physical and data link technologies, network and transport layer services and algorithms, plus application protocols and basic network security and management concepts. Practical lab work gives hands-on experience with network programming.

Course Objectives

The objective of the course is:

- Explain core concepts of data communication, protocol layering and network architectures.
- Understand physical and data link layer technologies, error detection/ correction.
- Apply IP addressing, subnetting and routing concepts for network planning and configuration.
- Explain transport layer mechanisms (TCP/UDP), flow/congestion control.
- Use and analyze application-layer protocols and network services; perform basic network programming.

Learning Outcomes

On successful completion of the course, the learners will be able to:

- Recall features and role of each layer in OSI and TCP/IP models.
- Analyze and implement error detection/correction and ARQ techniques for reliable link-layer transfer.
- Perform IP addressing, subnet masking and use IPv4/IPv6 addressing in practical scenarios.
- Compare and evaluate transport layer protocols (TCP, UDP) and their mechanisms for reliability and congestion control.
- Configure and troubleshoot common application layer services (HTTP, FTP, DNS, SMTP).

Course Outcomes (CO)

CO1: Remember features and applications of different layers of OSI and TCP/IP models.
CO2: Understand data link layer protocols to solve errors occur during communication.
CO3: Apply IP addressing and subnet masking to fulfil networking requirements.
CO4: Analyse the working of various protocols used for communication at transport layer.

CO5: Evaluate application layer protocols for real life application.

Modules

Module 1: Introduction & Physical Layer

Introduction to Networks and data communication: concepts and definitions, network types (LAN, WAN, MAN), network topologies.
Protocol layering: advantages of layered architecture, OSI model vs TCP/IP suite.
Physical layer responsibilities: signaling, bit transmission, performance metrics.
Transmission media: guided (twisted pair, coaxial, fiber) and unguided (wireless), characteristics and selection.
Switching basics.

Module 2: Data Link Layer & Error Control
Types of errors, error detection techniques (parity, checksums, CRC).
Error correction basics.
Data link control: framing, flow control and error control.
ARQ protocols: Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ.
Protocol examples: HDLC, Point-to-Point Protocol (PPP) and PPP stack.
Multiple access methods: random access (ALOHA, CSMA), controlled access, channelization.

Module 3: Network Layer
Network layer services and performance.
Basics: IPv4 addressing, IPv6 addressing, Subnetting.
Important network layer protocols: IP, ARP, RARP, DHCP, ICMP.
Routing: routing algorithms (distance vector, link state), basics of routing protocols.

Module 4: Transport Layer
Transport layer responsibilities: end-to-end communication, multiplexing, demultiplexing.
Ports and sockets.
UDP: characteristics and use cases.
TCP: connection management, reliable delivery, flow control.
TCP congestion control algorithm.

Module 5: Application Layer & Security Basics
Application layer services and client-server model, socket interface basics.
Application protocols: HTTP, FTP, SMTP, POP3, IMAP, Telnet, SSH, SNMP, DNS.
Remote login and file transfer concepts.
Data compression fundamentals and basic cryptography concepts.

Textbooks

1. Behrouz A. Forouzan, Data Communications and Networking.

2. William Stallings, Data and Computer Communications, Pearson.
3. Andrew S. Tanenbaum & David Wetherall, Computer Networks, Pearson.

Reference Books

1. Larry L. Peterson & Bruce S. Davie, Computer Networks: A Systems Approach, Morgan Kaufmann
2. James F. Kurose & Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson

List of Lab Programs

Lab Course Outcomes

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

CO1	To implement algorithms using network Programming.
CO2	To compare different algorithmic approaches to simulate different network topologies.
CO3	Create innovative solutions combining theory and implementation.
CO4	Analyse the working of various protocols used for communication at different layers.
CO5	Evaluate layer protocols for real life application

S. No.	Programs	CO No.
1	To learn handling and configuration of networking hardware like RJ-45 connector, CAT-6 cable, crimping tool, etc	
2	Configuration of router, hub, switch etc. (using real devices or simulators)	
3	Running and using services/commands like ping, trace route, nslookup, arp, telnet, ftp, etc	
4	Network packet analysis using tools like Wireshark, tcpdump, etc	
5	Network simulation using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.	
6	Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)	

7	Programming using raw sockets	
8	Programming using RPC	

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2		1							
CO2	3	3	2	2							
CO3	3	3	2	2	1						
CO4	2	2	3	3				2	1		
CO5	2	2	2	1	1	2		2	1	2	1

3 – High level of correlation
2 – Medium level of correlation
1 – Low level of correlation
Blank – No correlation