

**AI2003: COMPUTER NETWORK**

**Course Prerequisites:** Fundamentals of Computer, C/C++ programming.

**Course Objectives:**

1. Understand the importance of Computer Network and its usage.
2. Study error control and flow control techniques.
3. Solve real-world problems in the context of today's internet (TCP/IP and UDP/IP).
4. Distinguish and relate various physical Media, interfacing standards, and adapters.
5. Implement mathematically and logically the working of computer protocols in the abstract.

**Credits:** 4

**Teaching Scheme Theory:** 2 Hours/Week

**Tut:** 1 Hours/Week

**Lab:** 2 Hours/Week

**Course Relevance:**

A computer network is a system of interconnected computers and computerized peripherals such as printers. This interconnection among computers facilitates information sharing among them by using data communication. The main objective of a computer network is to enable seamless exchange of data between any two points in the world. This course will explore common network services and protocols such as email, web services, etc. Networking is an ever-growing domain in which there is a constant need for support. Networks are becoming progressively more and more convoluted as technology is advancing and flourishing.

**SECTION 1****Introduction**

Introduction to computer network, LAN, MAN, WAN, PAN, Ad-hoc Networks, Network Architectures- Client-Server, Peer To Peer, Network Topologies- Bus, ring, tree, star, mesh, hybrid. Communication Models- OSI Model, TCP/IP Model, Design issues for layers. **(3 Hours)**

**Physical Layer**

Transmission media- Guided media, unguided media. Transmission Modes- Simplex, Half-Duplex and Full-Duplex. Network Devices- Hub, Repeater, Bridge, Switch, Router, Gateways and brouter. Spread spectrum signal, FHSS, DSSS. **(3 Hours)**

**Data Link Layer**

Logical Link Layer- Services to Network Layer, Framing, Error Control and Flow Control. Framing in LLC- framing challenges, types of framing. Error Control in LLC- error detection, error correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols- Unrestricted Simplex, Stop and Wait, Sliding Window Protocol. WAN Connectivity- PPP and HDLC **.(5 Hours)**

**Medium Access Control**

Channel Allocation-Static and Dynamic, Multiple Access Protocols- Pure and Slotted ALOHA, CSMA, CSMA/CD, WDMA, IEEE 802.3 Standards and Frame Formats. **(4 Hours)**

**SECTION 2****Network Layer**

Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols- Distance Vector, Link State, Routing in Internet- RIP, OSPF, BGP, Congestion control and QoS. (6 Hours)

**Transport Layer**

Services, Socket programming, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP and UDP, TCP Timer management, Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless. (4 Hours)

**Application Layer**

Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP). (3 Hours)

**List of Tutorials: (Any Three)**

1. Identification of various network components
2. Establishing LAN
3. Installation of network device drivers
4. Use/installation of proxy server
5. Configuration of network devices in CISCO packet tracer (Windows/Linux)
6. Implement communication between various network devices using CISCO packet tracer (Windows/Linux)
7. Network traffic monitoring using Wireshark/Ethereal (Windows/Linux)

**List of Practical's: (Any Six)**

1. Study and implement various networking commands on the terminal.
2. Use Socket programming to create a Client and Server to send a Hello message.
3. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using the Wireshark Packet Analyzer Tool for peer-to-peer mode. (50% of students will perform Hamming Code and others will perform CRC)
4. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer-to-peer mode
5. Write a program to find the class and type of a given IP address.
6. Write a program to demonstrate subnetting and find the subnet masks.
7. Write a program using a TCP socket for the wired network for the following:
  - a. Say Hello to each other (For all students)
  - b. File transfer (For all students)
  - c. Calculator (Arithmetic) (50% students)
  - d. Calculator (Trigonometry) (50% students)
8. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video on file each) between two machines.
9. Write a program to implement: a. Network Routing: Shortest path routing, AODV. b. Analysis of congestion control (TCP and UDP).
10. Write a program to analyze the following packet formats captured through Wireshark for wired networks.

1. Ethernet 2. IP 3. TCP 4. UDP

### List of Course Projects:

1. Write a program using TCP sockets for wired networks to implement
  - a. Peer-to-Peer Chat b. Multi User Chat Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer-to-peer mode.
2. Implementation of shortest path protocol
3. Implementation of string encryption and decryption
4. Implementation of character stuffing and de-stuffing
5. Execution and analysis of Network commands
6. To find out details of the network from the IP addressing scheme using the 'C' code
7. Implement real-time Internet route optimization.
8. Implement Broadcast Server System.
9. Implement a real-time voting System.
1. 10. Real-time packet capture and analysis for malware in wireless networks.

### List of Course Seminar Topics:

1. Asynchronous Transfer Mode
2. Need Of Multiplexing for Signal Modulation
3. TDM with PAM a case study
4. Noise signal
5. Basic Network Protocols
6. Manchester Vs Differential Manchester coding technique
7. Amplitude Shift Keying: Working and Applications
8. Nyquist Sampling Theorem
9. CDMA
10. Line coding Techniques with example

### List of Course Group Discussion Topics:

1. TCP/IP Model
2. Mobile IP
3. Congestion Control and QoS
4. Wireless Technology for Short range and long range
5. Application Protocols and its security
6. IP Protocols
7. Data Communication Issues in IP Networks and Solutions to it
8. Congestion control in hybrid networks
9. Issues in Real time Audio and video transmission protocol.
10. IPV6

### List of Home Assignments:

1. Enumerate the challenges in Line coding. Draw the line code for the sequence 010011110 using Polar NRZ-L and NRZ-1 schemes.
2. Design the procedure to configure TCP/IP network layer services.
3. Simulation of Routing Protocols using NS2

4. Simulation of FTP based Protocols using CISCO packet Tracer/ NS2
10. Simulation of Congestion Control Protocols Using NS2

**Case Study:**

1. Amplitude and Frequency Modulation Technique
2. Digital to Analog and Analog to Digital converters
3. Study of Various VPNs
4. IoT Solutions to Current Network Requirements
5. Unix Solutions for Broadcast Systems

**Blog:**

1. Communication Protocol
2. Emerging Trends in Computer Networks
3. Use of IOT in Networks
4. Cloud-based Network Solutions for real-world problems
6. Recent Trends in Computer Security

**Surveys:**

1. Survey of Wireless Technologies
2. Survey of Congestion control methodologies
3. Survey of Bluetooth Technology
4. Survey of Virtual Private Networks
5. 5 Survey of ADHOC Networks

**Assessment Scheme:**

Practical End Semester Examination  
Lab Assessment  
Course Project CVV

**Text Books:**

1. James F. Kurose, and Keith W. Ross, "A Top-Down Approach," 4th edition, Publisher: Addison-Wesley ISBN: 0-321-49770-8
2. Behrouz A. Forouzan, "Data Communication and Networking", 4th edition, Tata McGraw Hill
- Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education

**Reference Books:**

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", Wiley, ISBN: 0-470-09510-5
3. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall, 2004

**Moocs Links and additional reading material:**

1. <https://nptel.ac.in/courses/106105183>
2. <https://www.my-mooc.com/en/categorie/computer-networking>

**COURSE OUTCOMES**

1. Select network architecture, topology and essential components to design computer networks.

2. Estimate reliability issues based on error control, flow control by using bandwidth, latency, throughput and efficiency.
3. Design mechanisms to demonstrate channel allocation in wired and wireless computer networks.
4. Analyze data flow between peer-to-peer in an IP network using Application, Transport and Network Layer Protocols.
5. Implement the client server application using socket. Develop Client-Server architectures and prototypes by the means of correct standards, protocols and technologies.

**Future Courses Mapping:**

1. Network Security
2. Cybersecurity
3. Software Defined Network

**Job Mapping:**

*Job opportunities that one can get after learning this course*

1. Network Administrator
2. System Engineer
3. Network Architect

**CO – PO Mapping :**

	Program Outcomes (PO)												PSO			
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3										2		2	
CO2	3	2		3	2								2	2		2
CO3	2	2	3				2				2		2			
CO4	2	2		3			2					2		2		
CO5	2				3	3		2	2	2	2	2				
CO6			2		2	3			2	2						2
Average	2.40	2.25	2.67	3.00	2.33	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00