| **Programme:** B. Tech. (CSE) | **Course Title:** Computer Networks | | | **Course Code:** CSE-332 |
|---|---|---|---|---|
| **Type of Course:** Program Core | **Prerequisites:** Data Structures and Algorithms | | | **Total Contact Hours:** 40 |
| **Year/Semester:** 2/Even | **Lecture Hrs/Week:** 3 | **Tutorial Hrs/Week:** 0 | **Practical Hrs/Week:** 2 | **Credits:** 4 |

**Learning Objective:**

The course focuses on understanding computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience installing, monitoring, and troubleshooting networks. The course enables the students to understand the fundamental concepts in the design and implementation of computer networks, design issues and responsibilities, components of the data communication model and communication architectures, and standard protocols, algorithms and applications supporting the network establishment and management.

**Course outcomes (COs):**

| **On completion of this course, the students will have the ability to:** | | **Bloom's Level** |
|---|---|---|
| **CO-1** | **Identify** the elements of a communication network and **describe** their significance in building the physical network infrastructure. | **1, 2** |
| **CO-2** | **Apply** knowledge of data communication and transmission techniques using various transmission media to deliver error-free data and communicate with multiple nodes. | **3** |
| **CO-3** | **Illustrate** the significance of logical addressing and **analyze** various routing methods to identify effective network communication protocols. | **3, 4** |
| **CO-4** | **Evaluate** network performance employing transport and flow control protocols, congestion control protocols and quality of services. | **5** |
| **CO-5** | **Identify** the new trends, technologies and their potential applications in computer networks and **examine** the use of networking concepts in realizing the social impact of the applications. | **1, 4** |

| **Course Topics** | **Lecture Hours** | |
|---|---|---|
| **UNIT – I (Introduction and Physical Infrastructure)** | **10** | **10** |
| 1.1 Introduction: data communication, data representation, data flow, types of network connections, physical topology; Categories of network: LAN, MAN, WAN; Overview of internetworking and intra-networking, protocols and standards. | **2** | |
| 1.2 Reference models: ISO/OSI – layered architecture, peer-to-peer processes, interfaces, layer organization, encapsulation, layer services and responsibilities; TCP/IP protocol suite and its layered architecture and addressing; Comparison between ISO/OSI and TCP/IP. | **4** | |

| | | |
|---|---|---|
| 1.3 Transmission media, transmission impairments, data rate limits for noisy and noiseless channels, performance measures: bandwidth, throughput, latency, bandwidth-delay product, bit length, data rate vs signal rate; transmission modes: parallel and serial; Encoding schemes: Manchester and Differential Manchester; Switching: circuit-switched network and packet-switched network. | **4** | |
| | | |
| **UNIT – II (Data Link Layer)** | **10** | **10** |
| 2.1 Design issues, error detection and correction: hamming distance, CRC, checksum; Data link control: framing, flow and error control for noiseless and noisy channels. | **4** | |
| 2.2 Multiple access: random access and contention, concept of collision, vulnerable time, throughput, multiple access method – ALOHA, CSMA, CSMA/CD. | **3** | |
| 2.3 IEEE 802.3 Ethernet: Ethernet evolution, frame format, addressing, access method, ethernet cabling, encoding, binary exponential backoff algorithm, ethernet performance. | **3** | |
| | | |
| **UNIT – III (Network Layer)** | **10** | **10** |
| 3.1 Design issues, Logical addressing: IPv4 and IPv6 addresses, classful and classless; Internet Protocol (v4 and v6), the transition from IPv4 to IPv6. | **4** | |
| 3.2 Address resolution and host configuration: ARP, RARP, BOOTP, DHCP; Error reporting and multicasting: ICMP (v4 and v6) and IGMP. | **3** | |
| 3.3 Delivery, forwarding and routing: types of delivery, forwarding techniques, routing table and its types; Routing protocols: distance vector routing – link state routing – path vector routing – RIP – OSPF – BGP. | **3** | |
| | | |
| **UNIT-IV (Transport Layer)** | **7** | **7** |
| 4.1 Connectionless transport protocol–UDP: datagram format, UDP operation, applications; Connection-oriented transport protocol–TCP: TCP services and features, TCP segment format, TCP connection, error control. | **4** | |
| 4.2 Congestion control: data traffic, traffic profiles, congestion, congestion control: open-loop and closed-loop, congestion control in TCP; Quality of services: flow characteristics, techniques to improve quality of services: scheduling, traffic shaping, resource reservation, admission control. | **3** | |
| | | |
| **UNIT-V (Application Layer)** | **3** | **3** |
| 5.1 Introduction to networking applications, The Web and HTTP, Electronic mail, Domain name system, file transfer protocol, SMTP, SNMP, and other domains of applications. | **3** | |

| **CN Laboratory** | **Lab Hours** | |
|---|---|---|
| **Experiments** | **20** | **20** |
| 1. Study of different physical devices and Local Area Network with its cables, connectors, and topologies. | **2** | |
| 2. Implementation of programs using different data link layer protocols to depict the concept of protocol data unit. | **2** | |

| | | |
|---|---|---|
| 3. Implement the concepts of packet loss, retransmission, and timeout for the communication among the nodes in the network. | **2** | |
| 4. Create the network topology to implement the concepts of forwarding network and perform routing in the forwarding network. | **2** | |
| 5. Implementation of programs using different network layer protocols to depict the concept of protocol data unit. | **2** | |
| 6. Design and configure the network systems using modern network simulator software. | **2** | |
| 7. Experimental study of the different tools and techniques used in setting, configuration, and management of the computer networks. | **2** | |
| 8. Implementation of programs using transport layer protocols – I. | **2** | |
| 9. Implementation of programs using transport layer protocols – II. | **2** | |
| 10. Experimental study and implementation of programs using different application layer protocols and understanding their design and configuration using modern network simulator software. | **2** | |

**Tools and Platforms:** As per current practices, the CN laboratory can be conducted using tools and platforms such, but not limited to, OMNeT++, Cisco Packet Tracer, GNS3, Putty, Wireshark, Network Simulator ns-3, SNMP Agent Simulator, etc.

**Textbook References:**

**Textbook:**

1. *Data Communications and Networking*, Behrouz A. Forouzan, Fifth Edition, McGraw Hill Education, 2017.
2. *Computer Networks*, Andrew S. Tanenbaum, David J. Wetherall, Fifth Edition, Pearson Education, 2013.

**Reference books:**

1. *Data and Computer Communications*, William Stallings, Ninth Edition, Pearson Education, 2013.
2. *Computer Networks: A Systems Approach*, Larry L. Peterson and Bruce S. Davie, Sixth Edition, Morgan Kaufmann Publishers Inc., 2021.
3. *Data* Networks, Dimitri Bertsekas and Robert Gallager, Second Edition, Prentice-Hall, Inc., 1992.
4. *Computer Networking: A Top-Down Approach*, James F. Kurose and Keith Ross, Seventh Edition, Pearson Education, 2016.
5. *Internetworking with TCP/IP Volume – I*, Douglas E. Comer, Sixth Edition, Pearson India, 2015.
6. *TCP/IP Illustrated Volume – I*, W. Richard Stevens, Second Edition, Addison Wesley, 2011.

| **Evaluation Method** | |
|---|---|
| **Item** | **Weightage (%)** |
| Quiz 1 | 10 |
| Quiz 2 | 10 |
| Lab | 25 |
| Midterm | 20 |
| Final Examination | 35 |

*Please note, as per the existing institute's attendance policy, the student should have a minimum of 75% attendance. Students who fail to attend a minimum of 75% of lectures will be debarred from the End Term/Final/Comprehensive examination.

**CO and PO Correlation Matrix (CSE)**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 1 | 3 | | | | | | | | 3 | 3 | 1 |
| CO2 | 2 | 1 | 2 | 1 | 3 | | | | | | | | 2 | 3 | 1 |
| CO3 | 2 | 2 | 2 | 3 | 3 | | | | | | | | 3 | 2 | 3 |
| CO4 | 3 | 1 | 2 | 1 | 3 | | | | | | | | 2 | 1 | 2 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | | | | 1 | 2 | 3 | 3 |

**CO and PO Correlation Matrix (ECE)**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 1 | 3 | | | | | | | | 1 | 1 | 1 |
| CO2 | 2 | 1 | 2 | 1 | 3 | | | | | | | | 2 | 1 | 1 |
| CO3 | 2 | 2 | 2 | 3 | 3 | | | | | | | | 3 | 1 | 1 |
| CO4 | 3 | 1 | 2 | 1 | 3 | | | | | | | | 1 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | | | | 1 | 2 | 2 | 3 |

**CO and PO Correlation Matrix (CCE)**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | 1 | 3 | | | | | | | | 1 | 1 | 1 |
| CO2 | 2 | 1 | 2 | 1 | 3 | | | | | | | | 2 | 1 | 1 |
| CO3 | 2 | 2 | 2 | 3 | 3 | | | | | | | | 3 | 1 | 1 |
| CO4 | 3 | 1 | 2 | 1 | 3 | | | | | | | | 1 | 2 | 1 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 1 | 1 | 3 | | | | 1 | 2 | 2 | 3 |

**Last Updated On: 29th November 2022**

**Updated By: Saurabh Kumar**

**Approved By:**