CMPE 101- COMPUTER ENGINEERING AS A DISCIPLINE

Module 8:

Networking and Communication Systems

Lesson Title: Introduction to Computer Networks, Data Communication, and Networking Technologies

Duration: 1 hour

Learning Objectives:

By the end of this lesson, students will be able to:

1. Understand the fundamentals of computer networks and the Internet.
2. Learn the basics of data communication and different network topologies.
3. Recognize the role of networking in modern computer engineering.
4. Differentiate between wired and wireless networks and identify emerging networking technologies.

I. Introduction to Computer Networks and the Internet (15 minutes)

1. **Definition of Computer Networks**:
    - A **computer network** is a group of interconnected devices that share resources and data using communication protocols.
    - Networks range from **local area networks (LANs)**, which cover small geographical areas, to **wide area networks (WANs)**, such as the Internet, which span the globe.
2. **The Internet**:
    - The **Internet** is the world's largest public WAN, connecting billions of devices worldwide using the **TCP/IP protocol**.
    - It enables the use of services such as **email**, **web browsing**, **cloud storage**, and more.
3. **Key Components**:
    - **Routers**: Forward data between networks.
    - **Switches**: Connect devices within a network.
    - **Servers**: Provide resources to other devices.
4. **Reference**:
    - **Tanenbaum, A. S., & Wetherall, D. J. (2020).** *Computer Networks* (6th ed.). Pearson.

II. Basics of Data Communication and Network Topologies (15 minutes)

1. **Data Communication**:
    - Data communication refers to the transfer of data between devices via a communication medium (e.g., copper wires, fiber optics, wireless signals).
    - **Key Elements**:
        - **Sender**: Device that transmits data.
        - **Receiver**: Device that receives the data.
        - **Transmission Medium**: Path through which data travels (e.g., cables, air).
        - **Protocol**: Set of rules for data transmission (e.g., TCP/IP, HTTP).
2. **Network Topologies**:
    - **Bus Topology**: All devices are connected to a single communication line.
    - **Star Topology**: All devices connect to a central hub or switch.
    - **Ring Topology**: Devices are connected in a circular manner.
    - **Mesh Topology**: Every device is connected to every other device, providing redundancy and fault tolerance.
3. **Reference**:
    - **Forouzan, B. A. (2021).** *Data Communications and Networking* (6th ed.). McGraw-Hill.

III. Role of Networking in Modern Computer Engineering (10 minutes)

1. **Enabling Communication**:
    - Networking is crucial for **communication** between devices, enabling systems to exchange data and share resources such as printers, servers, and storage devices.
2. **Distributed Systems**:
    - **Distributed computing** allows multiple computers to work together, splitting complex tasks across a network (e.g., cloud computing).
3. **Network Security**:
    - Networking plays a critical role in computer security, with protocols like **firewalls** and **VPNs** ensuring safe data transmission.
4. **Internet of Things (IoT)**:
    - Networking enables the IoT, where interconnected smart devices communicate with each other, providing innovations in healthcare, transportation, and industrial automation.
5. **Reference**:

- **Kurose, J. F., & Ross, K. W. (2021).** *Computer Networking: A Top-Down Approach* (8th ed.). Pearson.

IV. Wired vs. Wireless Networks and Emerging Technologies (15 minutes)

1. **Wired Networks**:
   - Wired networks use physical cables (e.g., Ethernet) to connect devices.
   - **Advantages**: High reliability, faster speeds, and security.
   - **Disadvantages**: Limited mobility and higher installation costs.
2. **Wireless Networks**:
   - Wireless networks use radio waves to transmit data, enabling mobility.
   - **Wi-Fi**, **Bluetooth**, and **cellular networks** (e.g., 4G, 5G) are common wireless technologies.
   - **Advantages**: Flexibility, ease of installation, and mobility.
   - **Disadvantages**: Susceptible to interference, lower speeds compared to wired networks.
3. **Emerging Networking Technologies**:
   - **5G Networks**: High-speed mobile networks offering faster data transmission and low latency.
   - **Software-Defined Networking (SDN)**: Provides centralized control over the network through software, improving flexibility and management.
   - **Network Function Virtualization (NFV)**: Allows network functions (e.g., firewalls, routers) to be virtualized, reducing the need for dedicated hardware.
4. **Reference**:
   - **Olsson, M. (2021).** *5G Networks: Concepts, Practices, and Practical Aspects*. Wiley.

V. Summary and Q&A (5 minutes)

- **Recap Key Points**:
  - The basics of computer networks and the Internet.
  - Key components of data communication and common network topologies.
  - The role of networking in modern computer engineering, from communication to IoT.
  - A comparison of wired vs. wireless networks, and emerging networking technologies like 5G and SDN.
- **Questions**: Open the floor for student questions.

References (2019-2024):

1. **Tanenbaum, A. S., & Wetherall, D. J. (2020).** *Computer Networks* (6th ed.). Pearson.
2. **Forouzan, B. A. (2021).** *Data Communications and Networking* (6th ed.). McGraw-Hill.
3. **Kurose, J. F., & Ross, K. W. (2021).** *Computer Networking: A Top-Down Approach* (8th ed.). Pearson.
4. **Olsson, M. (2021).** *5G Networks: Concepts, Practices, and Practical Aspects*. Wiley.