Third Year Even Semester  
Computer Networks

**Resources:**

1. [Computer networks, Andrew S. Tanenbaum - 5th edition](https://www.pdfdrive.com/computer-networks-e175307056.html)
2. [Data Communications and Networking, Behrouz A.Forouzan - 4th edition](https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxlZWJhaHJpYTV8Z3g6MjE2MzY2MjcxMGU3MmQ4Nw)
3. [Computer Networks - Neso Academy](https://www.youtube.com/playlist?list=PLBlnK6fEyqRgMCUAG0XRw78UA8qnv6jEx)
4. [Data Link Layer - Neso Academy](https://www.youtube.com/playlist?list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v)
5. [Cryptography & Network Security - Neso Academy](https://www.youtube.com/playlist?list=PLBlnK6fEyqRgJU3EsOYDTW7m6SUmW6kII)

**Introduction**

## [What is a Computer Network?](https://www.techopedia.com/definition/25597/computer-network): A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users.

[Internet | Description, History, Uses, & Facts](https://www.britannica.com/technology/Internet)

[Intranet - Wikipedia](https://en.wikipedia.org/wiki/Intranet)

**Introduction[1] - (Chapter - 1)**

* 1.1: Uses of Computer Networks
  + 1.1.1: Business Applications
  + 1.1.2: Home Applications
  + 1.1.3: Mobile Users
  + 1.1.4: Social Issues
* 1.2: Network Hardware
  + 1.2.1: Personal Area Networks
  + 1.2.2: Local Area Networks
  + 1.2.3: Metropolitan Area Networks
  + 1.2.4: Wide area Networks
  + 1.2.5: Internetworks
* 1.3: Network Software
  + 1.3.1: Protocol Hierarchies
  + 1.3.2: Design Issues for the Layers

**Introduction[2] - (Chapter - 1)**

* 1.2: Networks
  + Distributed Processing
  + Network Criteria
  + Physical Structures
  + Network Models
  + Categories of Networks
* 1.3: The Internet
* 1.4: Protocols and Standards

**IP Addressing**

[What Is an IP Address & What does it mean?](https://www.kaspersky.com/resource-center/definitions/what-is-an-ip-address)

[Network Address](https://www.geeksforgeeks.org/what-is-a-network-address/)

[Classless Inter-Domain Routing - Wikipedia](https://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing)

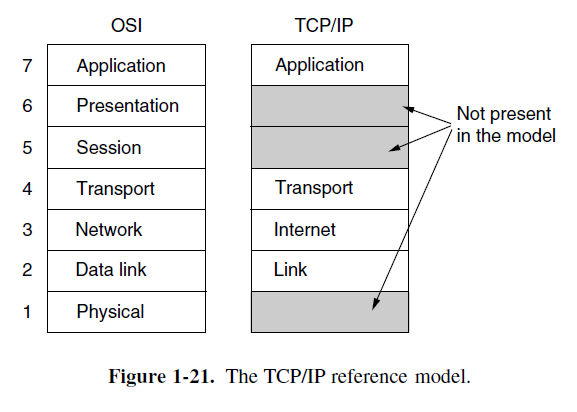
**Network Layer: Logical Addressing[2] - (Chapter - 19)**

* 19.1: IPv4 Addresses
  + Address Space
  + Notations
  + Classful Addressing
  + Classless Addressing
* 19.2: IPv6 Addresses

**Network Model**

**Introduction[1] - (Chapter - 1)**

* 1.4: Reference Models
  + 1.4.1: The OSI Reference Model
  + 1.4.2: The TCP/IP Reference Model
  + 1.4.4: A Comparison of the OSI and TCP/IP Reference Models
  + 1.4.5: A Critique of the OSI model and Protocols
  + 1.4.5: A Critique of the TCP/IP Reference Model
* 1.5: Example Networks
  + 1.5.1: The Internet

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**Network Models[2] - (Chapter - 2)**

* 2.1: Layered Tasks
  + Sender, Receiver, and Carrier
  + Hierarchy
* 2.2: The OSI Model
  + Layered Architecture
  + Peer-to-Peer Processes
  + Encapsulation
* 2.3: Layers in the OSI Model
  + Physical Layer
  + Data Link Layer
  + Network Layer
  + Transport Layer
  + Session Layer
  + Presentation Layer
  + Application Layer
* 2.4: TCP/IP Protocol Suite
  + Physical and Data Link Layers
  + Network Layer
  + Transport Layer
  + Application Layer

|  | Application layer | User Program |
| --- | --- | --- |
| Presentation layer |
| Session layer |
| Unit -> Segment | Transport Layer | end-to-end/port |
| Unit -> Packet | Network layer | Source to Destination/IP address |
| Unit -> Frame | Data Link layer | Node to Node/MAC address |
| Unit -> bit | Physical layer | Bit representation |

**Data Link Layer Design Issues and Framing**

**The Data Link Layer[1] - (Chapter - 3)**

* 3.1: Data Link Layer Design Issues
  + 3.1.1: Services Provided to the Network Layer
  + 3.1.2: Framing
    - [Framing in data link layer | Physical layer coding violation | Design Issues | Part-4/4](https://www.youtube.com/watch?v=M3IeTveg8js)
  + 3.1.3: Error Control
  + 3.1.4: Flow Control
* 3.2: Error Detection and Correction
  + 3.2.1: Error-Correcting Codes
    - Hamming Codes ([Hamming Code | Error detection](https://www.youtube.com/watch?v=1A_NcXxdoCc))
  + 3.2.2: Error-Detecting Codes
    - Parity
    - Checksums ([Checksum](https://www.youtube.com/watch?v=AtVWnyDDaDI))
    - Cyclic Redundancy Checks
      * [Cyclic Redundancy Check (CRC) - Part 1](https://www.youtube.com/watch?v=A9g6rTMblz4)
      * [Cyclic Redundancy Check (CRC) - Part 2](https://www.youtube.com/watch?v=wQGwfBS3gpk)
* 3.3: Elementary Data Link Protocols
  + 3.3.2: A Simplex Stop-and Wait Protocol for an Error-Free Channel
* 3.4: Sliding Window Protocols ([Sliding Window Protocol](https://www.youtube.com/watch?v=LnbvhoxHn8M&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=28))
  + 3.4.1: A One-Bit Sliding Window Protocol
  + 3.4.2: A Protocol Using Go-Back-N ([Go-Back-N ARQ](https://www.youtube.com/watch?v=QD3oCelHJ20&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=28))
  + 3.4.3: A Protocol Using Selective Repeat ([Selective Repeat ARQ](https://www.youtube.com/watch?v=WfIhQ3o2xow&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=31))
* [Sub-layers of the Data Link Layer](https://www.youtube.com/watch?v=N1apF49Ih28&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=2)
* [High-Level Data Link Control (HDLC)](https://www.youtube.com/watch?v=N2tgsPUPEBE&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=6)
* [Point-to-Point Protocol (PPP)](https://www.youtube.com/watch?v=kKCwkRT_U8I&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=9)

**Error Detection and Correction[2] - (Chapter - 10)**

* 10.1: Introduction
  + Types of Errors
  + Redundancy
  + Detection Versus Correction
  + Forward Error Correction Versus Retransmission
* 10.2: Block Coding
  + Error Detection
  + Error Correction
  + Hamming Distance
  + Minimum Hamming Distance
* 10.3: Linear Block Codes
  + Some Linear Block Codes
    - Simple Parity-Check Code
    - Hamming Codes
* 10.4: Cyclic Codes
  + Cyclic Redundancy Check
  + Polynomials
* 10.5: Checksum

**Data Link Control[2] - (Chapter - 11)**

* 11.1: Framing
* 11.2: Flow Control and Error Control
* 11.3: Protocols
* 11.4: Noiseless Channels
  + Stop-and-Wait Protocol
* 11.5: Noisy Channels
  + Stop-and-Wait Automatic Repeat Request
  + Go-Back-N Automatic Repeat Request
  + Selective Repeat Automatic Repeat Request
* 11.6: HDLC
* 11.7: Point-to-Point Protocol

**Multiple Access**

**The Medium Access Control Sublayer[1] - (Chapter - 4)**

* 4.2: Multiple Access Protocols ([Multiple Access Protocols](https://www.youtube.com/watch?v=YAjfUc7Tt24&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=36))
  + 4.2.1: ALOHA
    - Pure ALOHA ([Pure Aloha](https://www.youtube.com/watch?v=j4-r0e7DjqY&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=37))
    - Slotted ALOHA ([Slotted Aloha](https://www.youtube.com/watch?v=aqWTNk90zRA&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=38))
  + 4.2.2: Carrier Sense Multiple Access Protocols
    - [Carrier Sense Multiple Access (CSMA) – Part 1](https://www.youtube.com/watch?v=MAZi6VoekYw&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=39)
    - [Carrier Sense Multiple Access (CSMA) – Part 2](https://www.youtube.com/watch?v=PyLlYQXuxvs&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=40)
  + 4.2.3: Collision-Free Protocols
    - Reservation ([Controlled Access Protocol – Reservation](https://www.youtube.com/watch?v=baaPXiQ44vs&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=41))
    - Poling ([Controlled Access Protocol – Polling](https://www.youtube.com/watch?v=Zp8UBSEVPdc&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=42))
    - Token Passing ([Controlled Access Protocol – Token Passing](https://www.youtube.com/watch?v=ac5JI20hUjE&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=43))
  + [Channelization Protocols](https://www.youtube.com/watch?v=KviHyRss-dE&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=44)
  + 4.2.5: Wireless LAN Protocols
  + [Hidden Terminal Problem](https://www.youtube.com/watch?v=_oz4WTWRfGs&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=56)
  + [Exposed Terminal Problem](https://www.youtube.com/watch?v=mhuXdaRoLzA&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=57)
* 4.3: Ethernet
* 4.4: Wireless LANs
* 4.6: Bluetooth ([Bluetooth Protocol Stack](https://www.youtube.com/watch?v=eJKkEzeGuuo&list=PLBlnK6fEyqRhstjOChz8zuHiFoKGPMr9v&index=61))

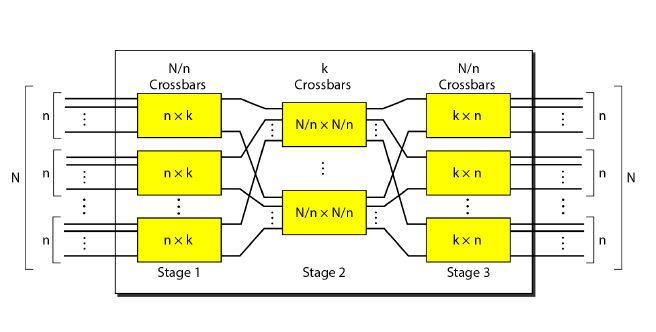
**Multiple Access[2] - (Chapter - 12)**

* 12.1: Random Access
  + ALOHA
  + Carrier Sense Multiple Access (CSMA)
  + Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
  + Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
* 12.2: Controlled Access
  + Reservation
  + Polling
  + Token Passing
* 12.3: Channelization
  + Frequency-Division Multiple Access (FDMA)
  + Time-Division Multiple Access (TDMA)
  + Code-Division Multiple Access (CDMA)

**Switching**

**Switching[2] - (Chapter - 8)**

* 8.1: Circuit-Switched Networks
  + Three Phases
  + Efficiency
  + Delay
* 8.2: Datagram Networks
  + Routing Table
  + Efficiency
  + Delay
  + Datagram Networks in the Internet
* 8.3: Virtual-Circuit Networks
  + Addressing
  + Three Phases
  + Efficiency
  + Delays in Virtual-Circuit Networks
* 8.4: Structure of a Switch
  + Structure of Circuit Switches
    - Space-Division Switch
      * Crossbar Switch
      * Multistage Switch



* + - Time-Division Switch
      * Time-Slot Interchange
    - Time and Space-Division Switch Combinations

[Message Switching](https://www.tutorialspoint.com/message-switching)

[Message switching techniques](https://www.geeksforgeeks.org/message-switching-techniques/)

**Network Layer: Internet Protocol[2] - (Chapter - 20)**

* 20.1: Internetworking
  + Need for Network Layer
  + Internet as a Datagram Network
  + Internet as a Connectionless Network

**The Network Layer[1] - (Chapter - 5)**

* 5.1: Network Layer Design Issues
  + 5.1.1: Store-and-Forward Packet Switching
  + 5.1.2: Services Provided to the Transport Layer
  + 5.1.3: Implementation of Connectionless Service
  + 5.1.4: Implementation of Connection-Oriented Service
  + 5.1.5: Comparison of Virtual-Circuit and Datagram Networks
* 5.2: Routing Algorithms
  + 5.2.1: The Optimality Principle
  + 5.2.2: Shortest Path Algorithm
  + 5.2.3: Flooding
  + 5.2.4: Distance Vector Routing
    - The Count-to-Infinity Problem
  + 5.2.5: Link State Routing
    - Learning about the Neighbors
    - Setting Link Costs
    - Building Link State Packets
    - Distributing the Link State Packets
    - Computing New Routes
  + 5.2.6: Hierarchical Routing
  + 5.2.7: Broadcast Routing
  + 5.2.8: Multicast Routing
* 5.3: Congestion Control Algorithms
  + 5.3.1
  + 5.3.2
  + 5.3.3
  + 5.3.4
  + 5.3.5
* 5.4: Quality of Service
  + 5.4.1
  + 5.4.2
  + 5.4.3
  + 5.4.4
* 5.5: Internetworking
* 5.6: The Network Layer in the Internet
  + 5.6.1
  + 5.6.2
  + 5.6.3

**Network Layer: Delivery, Forwarding, and Routing[2] - (Chapter - 22)**

* 22.2: Forwarding
  + Forwarding Process
    - Hierarchical Routing
    - Geographical Routing
  + Routing Table
    - Static Routing Table
    - Dynamic Routng Table

**Network Layer Protocols**

**Process-to-Process Delivery: UDP, TCP and SCTP[2] - (Chapter - 23)**

* 23.2: User Datagram Protocol (UDP)
  + Well-Known Ports for UDP
  + User Datagram
  + Use of UDP

**The Network Layer in the Internet[1] - (5.6)**

* 5.6.4: Internet Control Protocols
  + ICMP - The Internet Control Message Protocol
  + ARP - The Address Resolution Protocol

**Network Security**

**Network Security[1] - (Chapter - 8)**

* 8.1: Cryptography
  + 8.1.1
  + 8.1.2
  + 8.1.3
  + 8.1.4
  + 8.1.5
* 8.2: Symmetric-Key Algorithms
  + 8.2.5
* 8.3: Public-Key Algorithms
  + 8.3.1
  + 8.3.2
* 8.5: Management of Public Keys
  + 8.5.1
  + 8.5.3
* 8.7: Authentication Protocols
* 8.8: Email Security
* 8.9: Web Security

## [Cryptosystem](https://en.wikipedia.org/wiki/Cryptosystem)

[Symmetric Cipher Model](http://www.brainkart.com/article/Symmetric-Cipher-Model_8386/)

[Symmetric Cryptosystem](https://link.springer.com/referenceworkentry/10.1007%2F978-1-4419-5906-5_438)

Conventional Encryption

* [CONVENTIONAL ENCRYPTION](https://www.kdkce.edu.in/pdf/DCE_Chapter_4_%20I.pdf)
* [Conventional Encryption Algorithms](http://wiki.cas.mcmaster.ca/index.php/Conventional_Encryption_Algorithms)

Cryptosystem Classification

* By types of encryption operation used
  + Substitution cipher
  + Transposition cipher
* By number of keys used
  + Single-key or private
  + Two-key or private
* By the way in which plaintext is processed
  + [Block cipher](https://en.wikipedia.org/wiki/Block_cipher)
  + [Stream cipher](https://en.wikipedia.org/wiki/Stream_cipher)
  + [Difference between Block Cipher and Stream Cipher](https://www.geeksforgeeks.org/difference-between-block-cipher-and-stream-cipher/?ref=rp)

Cryptanalysis

* Unconditionally secure: A cipher that is unconditionally secure is one that is provably immune to compute power and to any form of attack.
* Computationally secure

[What is the difference between an unconditionally secure cipher and a computationally secure cipher?](https://www.quora.com/What-is-the-difference-between-an-unconditionally-secure-cipher-and-a-computationally-secure-cipher)

* + [Playfair cipher](https://en.wikipedia.org/wiki/Playfair_cipher)
    - [Playfair Cipher with Examples](https://www.geeksforgeeks.org/playfair-cipher-with-examples/)
  + [Hill cipher](https://en.wikipedia.org/wiki/Hill_cipher)
  + [Polyalphabetic Substitution Cipher](http://pi.math.cornell.edu/~mec/2003-2004/cryptography/polyalpha/polyalpha.html)
* [Difference between Monoalphabetic Cipher and Polyalphabetic Cipher](https://www.geeksforgeeks.org/difference-between-monoalphabetic-cipher-and-polyalphabetic-cipher/)
  + [Rail Fence Cipher - Encryption and Decryption](https://www.geeksforgeeks.org/rail-fence-cipher-encryption-decryption/?ref=rp)
  + Row Transposition Cipher
* [Difference between Substitution Cipher Technique and Transposition Cipher Technique](https://www.geeksforgeeks.org/difference-between-substitution-cipher-technique-and-transposition-cipher-technique/?ref=rp)
* [Product cipher](https://en.wikipedia.org/wiki/Product_cipher)
* [Steganography](https://en.wikipedia.org/wiki/Steganography)

**Others**