

Data Communication and Computer Network

EG3102CT

Year: II
Part: I

Total: 7 hours /week
Lecture: 3 hours/week
Tutorial: 1 hour/week
Practical: hours/week
Lab: 3 hours/week

Course description:

This course is designed to understand computer networks and digital data communications with a focus on Internet protocols: Application layer architectures (client/server, peer-to-peer) and protocols (HTTP-web, SMTP-mail, etc), Transport layer operation: (reliable transport, congestion and flow control, UDP, TCP); Network layer operation - (routing, addressing, IPv4 and IPv6), Data Link layer operation (error detection/correction, access control, Ethernet, 802.11, Physical Layer operation. Similarly, selected topics such as: network security (Network attack, cryptography, VPN, firewall).

Course objectives:

After completion of this course students will be able to:

1. Gain a good understanding of the architecture of computer networks.
2. Identify and understand various hardware devices and software used in computer networks.
3. Learn different types of protocols used for transmission of data.
4. Use routing and addressing.
5. Setup small home/office networks.

Course Contents:

Theory

Unit 1. Introduction **[4 Hrs.]**

- 1.1. Definition, Advantages and disadvantages, applications
- 1.2. Communication system: Analog and digital, Block diagram
- 1.3. Network as platform, Internet architecture, Trends in networking
- 1.4. Data Transmission: Analog and digital transmission
- 1.5. Transmission impairment

Unit 2. Network Architecture and Hardware/Software **[9 Hrs.]**

- 2.1. Network topologies
- 2.2. Network types: PAN, LAN, MAN, WAN, Intranet, Internet, Extranet
- 2.3. Layered network architecture, protocols, interfaces, services
- 2.4. OSI reference model
- 2.5. TCP/IP model
- 2.6. Network workstation and server: Hardware and software requirements
- 2.7. Client server and peer-to-peer model
- 2.8. Network devices: Repeater, Hub, NIC, Bridge, Switch, Router, Gateway

Unit 3. Physical Layer **[4 Hrs.]**

- 3.1. Channel bandwidth and throughput; Propagation time; transmission time
- 3.2. Transmission media:
 - 3.2.1. Guided: Coaxial, twisted-pair, fiber-optic
 - 3.2.2. Unguided: radio waves, microwaves, infrared, satellite
- 3.3. Introduction of Frame Relay, ATM, ISDN, PSTN and X.25

Unit 4. Data link Layer [6 Hrs.]

- 4.1. Introduction and function of data link layer and its issues
- 4.2. Framing
- 4.3. Flow Control issues at data link layer
- 4.4. Piggybacking and Sliding Window Protocol
- 4.5. Error Control issues at data link layer
- 4.6. Error Detection Method and Error Correction Method
- 4.7. Data Link Layer Protocol: HDLC, PPP

Unit 5. LAN Architectures/standards [4 Hrs.]

- 5.1. Introduction of LAN standards and architecture
- 5.2. Media access control, MAC address
- 5.3. ALOHA, FDDI, VLAN, CSMA/CD, Token ring, Token bus and IEEE 802.3, 802.4, 802.1(wireless LAN)

Unit 6. Network Layer [8 Hrs.]

- 6.1. Internetworking
- 6.2. Circuit switching and packet switching
- 6.3. Addressing issues at network layer
- 6.4. IP address, Different classes, Private and Public address
- 6.5. Subnet mask and sub-netting: Classless addressing; Network Address Translation (NAT)
- 6.6. Routing and its necessity; static and dynamic routing; interior and exterior routing
- 6.7. Dynamic routing and Static routing
- 6.8. Network layer protocols
- 6.9. Introduction to IPV6 and its necessity

Unit 7. Transport Layer [4 Hrs.]

- 7.1. Transport layer issues:
 - 7.1.1. Congestion control
 - 7.1.2. Flow control
 - 7.1.3. Quality of service
- 7.2. Transport layer addressing sockets, Port
- 7.3. Segmentation and reassembly
- 7.4. Connection oriented and connectionless service
- 7.5. TCP, UDP

Unit 8. Application Layer [4 Hrs.]

- 8.1. Application layer and its function
- 8.2. Electronic mail: SMTP, POP3, IMAP
- 8.3. File transfer: FTP, PUTTY, WinSCP
- 8.4. Web: HTTP, HTTPs
- 8.5. Dynamic host configuration protocol (DHCP)
- 8.6. DNS, WWW

Unit 9. Network Security [2 Hrs.]

- 9.1. Properties of Secure Communication
- 9.2. Network attacks: Active and Passive attacks

- 9.3. Cryptography: Symmetric Key and public key, Digital signature
- 9.4. Firewalls
- 9.5. Virtual private network

Practical:

[45 Hrs.]

In practical, students should be able to set up small networks. They should be able to configure network hardware and network software. Following lab exercises may be helpful.

1. Configuration of network interface card and various network devices like hub, switch, router, etc.
2. Cabling: Construction of straight- through and cross-over cable and verify the physical layer connectivity.
3. Configuration of workstation PC
4. Setup peer-to-peer networking and verify it
5. Configuration of server for client server networking; also verify it.
6. Familiarization with basic network commands: Observing IP address and MAC address, Setting IP address and default gateway in PC, Verifying network layer connectivity
7. Configure the PC to obtain IP from DHCP, Release the leased IP, Renew IP (for this there should a DHCP server) -6 and 7 merge
8. Create multiple networks and route packets across multiple networks using static routing
9. Dynamic routing (e.g., RIP) and default route
10. Configure HTTP, FTP, DHCP server and verify it
11. Configuration of DNS and e-mail server
12. Design of local area network (LAN)
13. Case study: Organizational visit to study existing network system

Note: Use packet Tracer software for performing the above practical lab works

| Final written exam evaluation scheme | | | |
|---|--|--------------|----------------------------|
| Unit | Title | Hours | Marks Distribution* |
| 1 | Introduction | 4 | 7 |
| 2 | Network Architecture and Hardware/software | 9 | 16 |
| 3 | Physical Layer | 4 | 7 |
| 4 | Data link Layer | 6 | 11 |
| 5 | LAN Architectures/standards | 4 | 7 |
| 6 | Network Layer: | 8 | 14 |
| 7 | Transport Layer | 4 | 7 |
| 8 | Application Layer | 4 | 7 |
| 9 | Network Security | 2 | 4 |
| | Total | 45 | 80 |

* There may be minor deviation in marks distribution.

References:

1. Behrouz Forouzan, "Data Communications and Networking", Edition 5, Tata McGraw-Hill., 2012.
2. Andrews S. Tanenbaum, David J Wetherall, "Computer Networks", Edition 5, Pearson Education, 2012.
3. William Stallings, "Data & Computer Communications", PHI, Edition 6, 2012.