

## A9-R4: DATA COMMUNICATION AND NETWORK TECHNOLOGIES

### Objective of the Course

This course will allow students to develop background knowledge as well as core expertise in data communication and networking (DCN) technologies, which one of the fastest growing industries in today's world. It forms an integral part of the modern Information and Communications Technology (ICT) in any organizations. Starting from intranet/extranet in small offices to the World Wide Web, principles of DCN play an important role in designing any modern telecom infrastructure. A major ramification of the fantastic growth of telecommunications and networking is a dramatic increase in the number of professions, where an understanding of DCN is essential for success. Today, students wanting to understand the concepts and mechanisms underlying DCN infrastructures come from a variety of academic and professional backgrounds. Hence, to be useful, a course on DCN infrastructures must be accessible to students without technical backgrounds while still providing technical material comprehensive enough to challenge more experienced readers. This course is designed with this new mix of students in mind. The course, being the first one on telecommunication and networking in the DOEACC hierarchy, starts from the very basics of communication technology and goes up to the Internet, spanning all the five layers of TCP/IP model. The students will be exposed to communication principles, different types of media, modulation techniques, multiplexing, switched networks, the Internet, TCP/IP suite, network security, mobile wireless communication, fiber-optic communications and the state-of-art networking applications. At the end of the course the students would know:

- Evolution of data communication and networking paradigms
- Principles of data communication, channel characteristics, signaling, modulation and encoding, and multiplexing (SONET/SDH)
- Various transmission media, their comparative study, fiber optics and wireless media
- Categories and topologies of networks (LAN and WAN) □ Layered architecture (OSI and TCP/IP) and protocol suites
- Channel error detection and correction, MAC protocols, Ethernet and WLAN
- Details of IP operations in the INTERNET and associated routing principles
- Operations of TCP/UDP, FTP, HTTP, SMTP, SNMP, etc.
- Strategies for securing network applications in enterprises
- Emerging technologies, such as WDM mesh, mobile telephony etc

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### Outline of Course

| S. No. Topic                          | Minimum number of hours |
|---------------------------------------|-------------------------|
| 1. Data Communications                | 06                      |
| 2. Communication Network Fundamentals | 08                      |
| 3. Media Access Control               | 06                      |
| 4. Networking Components              | 06                      |
| 5. Link Control and MAC Protocols     | 05                      |
| 6. Local Area Networks (LAN)          | 05                      |

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|-----------------------------|----|
| 7. Wide Area Networks (WAN) | 08 |
| 8. Application Protocols    | 08 |
| 9. Wireless Networks        | 03 |
| 10. Security and Management | 05 |

**Lectures = 60**  
**Practical/tutorials = 60**  
**Total = 120**

## Detailed Syllabus

### **1. Data Communications** **06 Hrs.**

Introduction, Communication Systems, Signal and data, Transmission modes, Synchronous and asynchronous transmission, Circuits, channels and multi channeling, Signaling, Encoding and decoding, Error detection and Recovery, Flow control, Sliding Window, Congestion Management, Multiplexing [FDM, TDM, CDM, WDM] and Spreading[DS. FH], Concept of Modulation, Baseband versus Broadband; Pulse Code Modulation (PCM), Shift Keying [ASK, FSK, PSK, QPSK, DPSK]; Encoding techniques and CODEC; Classification of Modems, Standards and Protocols, Protocols used by Modem to Transfer files, Establishing a Connection (Internet connectivity); Digital Subscriber Loop (DSL)

### **2. Communication Network Fundamentals** **08 Hrs.**

Introduction, Switching techniques: Circuit Switching, Packet switching, Datagram, Virtual circuit and Permanent Virtual Circuit, Connectionless and connection oriented communication, Message switching, Cell switching (ATM); Telephone network signaling Network topologies, Layering the communication process, Open Systems Interconnection(OSI) model, Data encapsulation; Protocols, services and layering, PDU/SDU; TCP/IP suite, Hour-glass model, Internet Architecture and Protocol overview.

### **3. Media Access Control** **6 Hrs.**

Introduction, Access Techniques (STDM, FDMA, TDMA, Spread Spectrum techniques and CDMA, DSSS, FHSS); Media Access Control: Aloha and Slotted Aloha, Media Access Control Address, Polling, CSMA, CSMA/CA, CSMA/CD and Reservation Aloha, Digital hierarchies [SONET/SDH]

### **4. Network Components** **06 Hrs.**

Introduction, LAN Hardware, LAN Operating Systems, Transmission Media: Guided Media(Twisted pair, Co-axial cable, Optical fiber); Unguided Media (Radio, VHF, microwave, satellite, Infrared); Fiber Optics Communication Components (Source, Channel Detector).

## **5. Link Control and MAC Protocols**

**05 Hrs.**

Framing, Error Detection and Correction; Window-based Flow Control; Logical Link Control, HDLC Protocol, Point-to-Point Protocol (PPP), X.25 CCITT standard for packet data transmission; Media access control, Random Access Techniques, Scheduling Mechanisms.

## **6. Local Area Network (LAN)**

**05 Hrs.**

LAN topologies and protocols; IEEE 802 Standard; Ethernet (Standard, Fast, Gigabit), Token Ring, FDDI, Wireless LANs (802.11x); Connecting LANs: Repeaters, Bridges, Switches, Routers; Virtual LANs

## **7. Wide Area Network (WAN)**

**08 Hrs.**

Network Layer Addressing and Routing concepts (Forwarding Function, Filtering Function); Routing Methods (Static and dynamic routing, Distributed routing, Hierarchical Routing); Distance Vector Protocol, Link State protocol, Open Shortest Path First (OSPF); Internet Protocol (IP): Addressing & Routing; Internet Control Message Protocol, (ICMP), Address Resolution Protocol (ARP), Dynamic Host Control Protocol (DHCP), Network Address Translation (NAT), IPv6, Mobile IP Process-to-Process delivery in Transport Layer: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), congestion control

## **8. Application Protocols**

**08 Hrs.**

Client/Server Model, Network File System (NFS), Remote Login: Telnet; File Transfer Protocol (FTP), Trivial File Transfer Protocol (TFTP); E-mail system: Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP); World Wide Web (WWW), Domain Name System (DNS), DNS servers; Hyper Text system: Hyper Text Transfer Protocol (HTTP), Hyper Text markup Language (HTML)

## **9. Wireless Networks**

**03 Hrs.**

Radio Communications, Cellular Radio, Mobile Telephony (GSM & CDMA), Satellite Networks (VSAT), Mobile Adhoc Networks (MANET).

## **10. Security and Management**

**05 Hrs.**

Cryptography, IPsec, SSL/TLS, PGP, secure HTTP, proxy, firewall, VPN; Simple Network Management Protocol (SNMP), Network policies.

## **RECOMMENDED BOOKS**

### **MAIN READING**

1. Behrouz A Forouzan, "Data Communication and Networking", Tata McGraw-Hill, 2008

2. William Stallings, "Data and Computer Communications", Pearson Education, 2008.
3. Rajneesh Agrawal and Bharat Bhushan Tiwari, "Data Communication and Computer Networks", Vikas Publishing house Ltd. , 2005.
4. Tomasi Wayne, "Introduction to Data Communications and Networking", Pearson Education, 2007.

#### **SUPPLEMENTARY READING**

1. A. S. Tanenbaum, "Computer Networks", Fourth Edition, Pearson Education.
2. A. Leon-Gracia and I. Widjaja, "Communication Networks", Tata McGraw Hill, 2004.
3. K. Pahlavan and P. Krishnamurthy, "Principles of Wireless Networks", EEE/Prentice Hall of India, 2003.