Course Title: Data Communication and Networks **Credit: 3**
Course No: CSIT.222 **Number of period per week: 3+3**
Nature of the Course: Theory + Lab **Total hours: 45+45**
Year: Second, Semester: Fourth
Level: B. Sc. CSIT

1. Course Introduction

This course provides an in-depth discussion of computer networks. It includes a detailed discussion of the different Network Models. Concepts that have a direct effect on the efficiency of a network (e.g. collision and broadcast domains, topology) are also discussed. Concepts on different network technologies, distributed computation, networking, and communication software, and security issues are also discussed.

2. Objectives

Towards the end of the course, students are expected to / able to:

- Be familiar with the different Network Models.
- Understand different network technologies
- Understand the effects of using different networking topologies
- Be updated with different advanced network technologies that can be used to connect different networks
- Be familiar with various hardware and software that can help protect the network
- Know the advantage of using a network management system

3. Specific Objectives and Contents

Specific Objectives	Contents
• Describe the basic concept of communications and the electronic implementation of communications paradigms. • Identify the characteristics and the analyze the signals properties	**Unit I: Data Communication Fundamentals (3)** 1.1. Data Communication: Components, Network vs Data Communication, Data vs Signal 1.2. Signal: Analog and Digital Signal, Signal Characteristics: Frequency, Amplitude, Phase, Periodic Signal, Square Wave, Signal Propagation 1.3. Network: Network Models, Categories of Network, Networked Data Processing: Centralized Processing, Distributed Processing, Client/Server Processing
• Describe the design issues related to data transfer • Compare and contrast the circuit and packet switching technologies	**Unit II: Data Transmission Mechanisms (8)** 2.1. Communication Modes: Simplex, Half-duplex, Full – duplex 2.2. Transmission Modes: Serial Transmission, Parallel Transmission

• Differentiate virtual circuits from datagram services. • Understand the techniques of converting data into signals	2.3. Synchronization: Asynchronous Transmission, Synchronous Transmission. 2.4. Introduction to Packet Switching: Circuit Switching vs. Packet Switching, Types of Services: Connection Oriented Services (Virtual Circuits) Connectionless Services (Datagram), Structure of a Switch, 2.5. Data Encoding: Analog to Digital (Pulse Code Modulation, Delta Modulation), Analog to Analog (AM, FM, PM), Digital to Digital (Line Coding, Block Coding), Digital to Analog (ASK, FSK, PSK).
• Describe different network topologies with their strength and drawbacks. • Understand data transmission characteristics of transmission media. • Quantify performance of different transmission system. • Explain role and importance of protocol architecture • Understand protocol header and their use	**Unit III: Network Architectures (6)** 3.1. Network Topologies: Bus, Ring. Star, Tree, Mesh, Hybrid 3.2. Transmission Media: Guided Media: Twisted Pair Cable, Coaxial Cable, Unguided Media: Microwave, Radio Wave, Infrared Wave 3.3. Transmission Impairments: Impairements in Guided Media, Impairements in unguided Media. 3.4. Physical Layer Interfaces: RS 232 / EIA 232/ USB 3.5. Network Performance: Bandwidth, Throughput, Latency. 3.6. Protocols: Syntax, Semantics & Timing, Protocol architecture and Importance, OSI Reference. TCP/IP Protocol Suit 3.7. TCP and IP Headers with Field Description
• Describe evolution of internet and protocols used. • Apply and understand different computer addressees. • Understand different IP address classes. • Apply concept of Subnetting in efficient network design. • Differentiate TCP from UDP protocols. • Describe role of different Internet and application layer protocols	**Unit IV: Internet Protocols (10)** 4.1. Introduction: Evolution of Internet, History of the Internet Protocols, Internet Protocol Stack, 4.2. Computer Addresses: IP Address, MAC Address, Ports. 4.3. IP Addressing: Public and Private IP Addresses, Classes of IP Addresses, Subnetting with Numerical Examples. 4.4. Transport Layer protocols TCP (Transmission Control Protocols), UDP (User Datagram Protocols), 4.5. IP Support Protocols: ARP (Address Resolution Protocol), DHCP (Dynamic Host Control Protocol), ICMP (Internet Control Management Protocol) 4.6. Application Layer Protocols: Domain Name System (DNS), Email (SMTP, POP, IMAP), FTP, HTTP, RTP and VoIP 4.7. IP version 6: Need and Concept
• Introduce the ways of achieving transmission efficiency. • Discuss different techniques of multiplexing	**Unit V: Transmission Efficiency (4)** 5.1. Introduction: Concept and Importance, Multiplexing and Data Compression. 5.2. Multiplexing: Frequency Division Multiplexing,

• Understand principles behind data compression.	Wave-Length Division Multiplexing, Synchronous Time Division Multiplexing, Statistical Time Division Multiplexing. 5.3. Data Compression, Lossy and Lossless Compression, Run-Length Encoding.
• Understand need and importance of flow control and error control • Exemplify different flow control techniques • Discuss different error detection techniques and compare them • Explain ARQ based error correction strategies	**Unit VI: Error and Flow Control Techniques (4)** 6.1. Flow Control: Stop and Wait Protocol, Sliding Window Protocol 6.2. Error Detection: Parity Bits, Cyclic Redundancy Check (CRC), Hamming Distance 6.3. Error Correction: Stop-and-Wait ARQ, Go-Back-N ARQ. 6.4. Data Link Control Protocols: HDLC Frame Structure. HDLC Operation
• Discuss different access protocols. • Describe working of different interconnecting devices. • Explain different layers in LAN protocol. • Discuss different variations of Ethernet. • Understand importance and architecture of wireless LANS	**Unit VII: Local area Networks (4)** 7.1. Access Protocols: CSMA/CD, CSMA/CA, Token Passing 7.2. Interconnecting devices: Hubs, L2 /L3 Switch, Bridge, Router and their Working & Comparisons. Repeater, Amplifier 7.3. Layered LAN Protocol, Physical layer, LLC Layer, MAC Layer. 7.4. Ethernet Variants: Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10Gb Ethernet, Standard Ethernet Physical Layer Implantation 7.5. Wireless LAN: Architecture, Bluetooth architecture
• Discuss different wide area network alternatives. • Describe SONET architecture and layers • Explain frame relay and ATM architecture and layers	**Unit VIII: Wide Area Networks(4)** 8.1. SONET/SDH: Architecture, SONET Layers, SONET Frames, SONET Networks 8.2. Frame Relay: Architecture, Frame Relay Layers, Extended Addresses 8.3. ATM: Design Goals, Problems Architecture, Switching, ATM Layers, Congestion Control
• Exemplify frequency reuse principles in cellular networks • Discuss first second and third generation cellular telephony • Describe use of GEO, MEO and LEO	**Unit IX: Cellular Telephony (2)** 9.1 Frequency Reuse Principle, Transmitting, Receiving, Roaming 9.1 First Generation Second Third Generation, Third Generation 9.1 Satellite Networks: Orbits, Footprints, Three Ctagories of Satellites: GEO, MEO & LEO

Evaluation System

Undergraduate Programs							
External Evaluation	**Marks**	**Internal Evaluation**	**Weightage**	**Marks**	**Practical**	**Weightage**	**Mark**
End semester examination	60	Assignments	20%	20	Practical Report copy	25%	20
(Details are given in the separate table at the end)		Quizzes	10%		Viva	25%	
		Attendance	20%		Practical Exam	50%	
		Internal Exams	50%				
Total External	60	Total Internal	100%	20		100%	20
Full Marks 60+20+20 = 100							

External evaluation

1. **End semester examination:**
   It is a written examination at the end of the semester. The questions will be asked covering all the units of the course. The question model, full marks, time and others will be as per the following grid.

2. **External Practical Evaluation:**
   After completing the end semester theoretical examination, practical examination will be held. External examiner will conduct the practical examination according to the above mentioned evaluation. There will be an internal examiner to assist the external examiner. Three hours tivme will be given for the practical examination. In this examination Students must demonstrate the knowledge of the subject matter.

   Full Marks: 100, Pass Marks: 45, Time: 3 Hrs

Nature of question	Total questions to be asked	Total questions to be answered	Total marks	Weightage
Group A: multiple choice*	20	20	20×1 = 20	60%
Group B: Short answer type questions	7	6	6×8 = 48	60%
Group C: Long answer type question/long menu driven programs	3	2	2×16 =32	60%
			100	100%

Each student must secure at least 50% marks in internal evaluation in order to appear in the end semester examination. Failed student will not be eligible to appear in the end semester examinations.

Internal evaluation

Assignment: Each student must submit the assignment individually. The stipulated time for submission of the assignment will be seriously taken.

Quizzes: Unannounced and announced quizzes/tests will be taken by the respective subject teachers. Such quizzes/tests will be conducted twice per semester. The students will be evaluated accordingly.

Attendance in class: Students should regularly attend and participate in class discussion. Eighty percent class attendance is mandatory for the students to enable them to appear in the end semester examination. Below 80% attendance in the class will signify NOT QUALIFIED (NQ) to attend the end semester examination.

Presentation: Students will be divided into groups and each group will be provided with a topic for presentation. It will be evaluated individually as well as group-wise. Individual students have to make presentations on the given topics.

Mid-term examination: It is a written examination and the questions will be asked covering all the topics in the session of the course.

Discussion and participation: Students will be evaluated on the basis of their active participation in the classroom discussions.

Instructional Techniques: All topics are discussed with emphasis on real-world application. List of instructional techniques is as follows:

- Lecture and Discussion
- Group work and Individual work
- Assignments
- Presentation by Students
- Quizzes
- Guest Lecture

Students are advised to attend all the classes and complete all the assignments within the specified time period. If a student does not attend the class(es), it is his/her sole responsibility to cover the topic(s) taught during that period. If a student fails to attend a formal exam/quiz/test, there won't be any provision for re-exam. Unless and until the student clears one semester he/she will not be allowed to study in the following semesters.

Laboratory Work

Since the class is primarily focused on the theory behind data networks, the purpose of the project is to introduce students to state of the art technology. Students will be asked to select a

particular technology that is of interest to you and study the state of the art in that technology area. At the end of the term, you will have to submit a brief written report, and (perhaps) give a 15 minutes oral presentation on that technology. Besides this, there will be lab session that includes cabling, IP configuration, DNS configuration, DHCP configurations etc.

Prescribed Text

- Behrouz A. Frouzen, Data Communications and Networking, McGraw-Hill, Fourth Edition, 2007

Reference

- William Stalling, Data and Computer Communications, Prentice Hall Publications, Tenth Edition, 2013
- Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, Prentice Hall, Fifth Edition, 2010