**SIR SYED UNIVERSITY OF ENGINEERING & TECHNOLOGY**
**COMPUTER SCIENCE DEPARTMENT**

# COURSE INFORMATION SHEET
# (For Theory + Lab Based Course)

**Session:** Spring-2021

**Course Title:** Data Communication & Networks

**Course Code: CS-328**

**Credit Hours: 3+1**

**Semester: 5th**

**Pre-Requisites: NIL**

**Instructor Name:** Waleej Haider, Razia Nisar Noorani

**Email and Contact Information:**
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Ext: 307, 315

**WhatsApp Group**

**Office Hours: 9 am – 5:00 pm** ✓

**Mode of Teaching:** Synchronous/Asynchronous/ Hybrid/Blended

**COURSE OBJECTIVE:**

- To help students gain a general understanding of the principles and concepts governing the operations of the computer networks;
- To provide the students with the opportunity to become skillful in implementation and use of communication protocols and network-based application software.
- To acquaint students with the layered approach that makes design, implementation and operation of extensive networks possible.

**COURSE OUTLINE:**

Introduction to Data Communication concepts, Physical Structures and topologies, Peer –to-peer applications, The Network Core, Circuit and Packet Switching, FDM, TDM, STDM. Delays in packet switched networks. Data and signals, Analogue and digital Transmission, Noise, Media impairments, Signal Encoding, Asynchronous and Synchronous transmission. Error correction Techniques. Types of Network system architectures (OSI, TCP/IP), Error Control, Flow Control, Data Link Protocols, Bridging. Data link layer Protocols. Types of Local Area Networks, MAC Layer protocols, Multiplexing, Switched and IP Networks, Inter-networking, Routing. Transport Layer protocols TCP, UDP and SCTP. Application Layer Protocols. Types of Wireless LANs. Routing Algorithms, Multiple Access Links and Protocols, Wireless and Mobile Networks, Multimedia Networks

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**COURSE LEARNING OUTCOMES (CLOs) and its mapping with Program Learning Outcomes (PLOs):**

| CLO No. | Course Learning Outcomes (CLOs) | PLOs | Bloom's Taxonomy |
|---|---|---|---|
| 1 | **Define** the principles of data communication to perform Analogue and digital Transmission. Understanding of the basic concepts of data communications and networking | NIL | C1 (Remembering) |
| 2 | Be able to **explain** how noise, attenuation, and distortion affect signal transport, encoding methods of analog and Digital data digital transmission. Flow and Congestion Control | NIL | C2 (Understand) |
| 3 | Design and **Implement** LAN and WAN network environment using Switches, Routers, IP addressing, sub-netting and supernetting to satisfy desired network requirements | NIL | C3 (Apply) |

**COMPLEX ENGINEERING PROBLEM/ACTIVITY:**

| | |
|---|---|
| **Complex Engineering Problem Details** | **Included: NO**<br>Nature and details of Complex Engineering Problem (CEP): It will be given in Assignment # 0X.<br><br>CEP will be based on CLO-X "Students have to develop learning about ----------<br>----------<br>----------.<br>To investigate the problem, students use in-depth knowledge related to the following concepts: ----------<br>----------<br>----------<br>----------.<br><br>**Attributes could be: WP1, WP3, WK5, WK8**<br>WP1: Depth of knowledge required<br>WP3: Depth of analysis required<br>WK5: Engineering Design<br>WK8: Research Literature<br>Assessment in: Assignment # 0X |
| **Complex Engineering Activity Details** | **Included: No**<br>Activity: Project Assigned to 2-3 students in a group<br><br>Provide the complete details of the Complex Engineering Activity along with the Attributes. |

**RELATIONSHIP BETWEEN ASSESSMENT TOOLS AND CLOs:**

| Assessment Tools | CLO-1 (Marks) | CLO-2 (Marks) | CLO-3 (Marks) |
|---|---|---|---|
| **Quizzes (5)** | 1 | 2 | 2 |
| **Assignments** | 1 | 2 | 2 |
| **Midterm Exam** | 4 | 8 | 8 |
| **Final Exam** | 10 | 20 | 20 |
| **Lab Assessment** | 4 | 8 | 8 |

**GRADING POLICY:**

| Assessment Tools | Percentage |
|---|---|
| Quizzes | 5% |
| Assignments | 5% |
| Midterm Exam | 20% |
| Final Exam | 50% |
| Lab Assessment | 20% |
| **TOTAL** | **100%** |

**Recommended Book:**

- Computer Networking: A top-down approach using the Internet James Kurose, Keith Rose (6th edition), 2017

**Reference Books:**

- Data and Computer Communications By William Stallings 9th Edition 2011
- Data Communications and Networking, by Behrouz A. Forouzan, 5th Edition, 2013

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**COURSE BREAKDOWN WITH LAB SYNCHRONIZATION:**

- **Both sides same Colours:** Lab is synchronized with the topic
- **Red Color:** Lab is not synchronized (*conducted before theory*)
- **No Color:** Lab is to introduce new hardware or software skill / Open Ended Lab / Lab is relevant to a topic taught in pre-requisite and required for upcoming labs

| Week No. | Topics | Laboratory Synchronization |
|---|---|---|
| 1 | Data communications<br>Networks<br>Network topologies<br>The internet<br>The internet today<br>Protocols and standards | Data communication, networking and its topologies*types of network, implement topologies on cisco packet tracer |
| 2 | Delay in packet-switched networks | Introduction to IOS (internetwork operating system).<br>Implement basic commands of IOS. |
| 3 | Data transmission | Study data transmission media and its type.<br>Making Straight through cable using RJ-45 connector. |
| 4 | Addressing: physical addresses, logical addresses, subnetting | Implement IP addressing & subneting on CISCO Packet Tracer. |
| 5 | Network devices<br>End user devices<br>Network connecting devices | To implement different topologies on packet tracer. To study how router will configure through different networks. |
| 6 | Network connectivity devices | Implement router on a stick. Basic commands of IoS. |
| 7 | TCP/IP protocol suite | Open ended lab |
| 8 | Mid-Term | |
| 9 | Application layer protocols<br>HTTP, FTP, SMTP, POP3 | Implementation of FTP, SMTP, POP3 in a simulator |

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|---|---|---|
| **10** | The data communicatioin interface: asynchronous and synchronous | Implement DHCP server in multi vlan. Enabling DHCP server in same network. |
| **11** | Routing in switched networks | Configuring Of RIP (routing information protocol) |
| **12** | Routing algorithms<br>Link state algorithm | Configuring EIGRP (enhanced interior gateway routing protocol) |
| **13** | Distance vector algorithm | Implement OSPF (open shortest path first) |
| **14** | Data link control<br>Protocols<br>Flow control | Configuring static routes on cisco routers.<br>configuring default route<br>To configuring of different network by using different routing protocols |
| **15** | Distance vector algorithm | Implement Distance vector algorithm |
| **16** | Multimedia Networks | Final exam/viva |

## LECTURE PLAN

**Course Title: Data Communication & Networks**
**Course Code: CS-328**

| Week # | Week Date | Course plan | Required Reading | Key Date |
|---|---|---|---|---|
| Week 1 | 15-02-2021 to 19-02-2021 | ➢ **1. Introduction.**<br>DATA COMMUNICATIONS<br>▪ Components<br>▪ Data Representation<br>▪ Data Flow | Beh-Chap 1: pg. 1 – 11<br>Beh-Chap 1 : Pg. 29 | |
| | 22-02-2021 to 26-02-2021 | ➢ NETWORKS<br>▪ Types of Connections<br>▪ Network Criteria<br>▪ Physical Structures<br>▪ Network Models<br>▪ Categories of Networks<br>▪ Interconnection of Networks: Internetwork | Beh-Chap 1 : Pg. 14, 16, 23 | |

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|---|---|---|---|---|
| Week 2 | 01-03-2021 to 05-03-2021 | ➢ Network Topologies<br>➢ THE INTERNET<br>➢ The Internet Today<br>➢ PROTOCOLS AND STANDARDS<br>▪ Protocols<br>▪ Data Comm. Standards<br>▪ Standards Organizations | Beh-Chap 2: Pg. 53, 56, 60 | |
| | 08-03-2021 to 12-03-2021 | ▪ Peer –to-peer applications<br>➢ The Network Core<br>▪ Circuit and Packet Switching | Kurose –Ch.1 pg. 22, Beh-Chap 2: Pg. 57 | |
| Week 3 | 15-03-2021 to 19-03-2021 | FDM, TDM, STDM | Kurose –Ch.1 pg. 27. Beh-Chap 3: pg. 71 Wil-Chap 3: pg. 88 | |
| | 22-03-2021 to 26-03-2021 | • Overview of Delay in Packet-Switched Networks | Kurose –Ch.1 pg. 28. Wil-Chap 3: pg. 79 | |
| Week 4 | 29-03-2021 to 02-04-2021 | ➢ DATA TRANSMISSION<br>▪ Concepts and Terminology<br>▪ Analog and Digital Data Transmission | Beh-Chap 4: pg. 109 | |
| | 15-02-2021 to 19-02-2021 | ▪ Time and Frequency Domain Concepts<br>▪ Relationship b/w Data Rate and Bandwidth<br>▪ Bandwidth Categories | Wil-Chap 3: pg. 68. Beh-Chap 4: pg. 129 | |
| Week 5 | 22-02-2021 to 26-02-2021 | ▪ Transmission Impairments<br>▪ Channel Capacity<br>▪ Bit And Baud Rates | Wil-Chap 3: pg. 78. Beh-Chap 5: pg. 175 | |
| | 01-03-2021 to 05-03-2021 | ➢ Signal Encoding Techniques<br>Unipolar Polar Bipolar PAM PCM<br>o Digital data, digital signals NRZ, NRZ-I, Bipolar AMI | Wil-Chap 5: pg. 141. Beh-Chap 5: pg. 179, 185 | |
| Week 6 | 08-03-2021 to 12-03-2021 | o Pseudoternary<br>o Manchester<br>o Differential Manchester | Wil-Chap 5: pg. 162. Wil-Chap 6: pg. 200 | |
| | 15-03-2021 to 19-03-2021 | Error correction Techniques<br>Flow Control | Wil-Chap 6: pg. 211, 215 | |
| Week 7 | 22-03-2021 to 26-03-2021 | Introduction to Computer Networks<br>➢ LAYERED TASKS<br>▪ Sender, Receiver, and Carrier<br>▪ Hierarchy | Wil-Chap 2: pg. 33 | |
| | 29-03-2021 to | Standardization within a protocol architecture | Wil-Chap 2: pg. 60 | |

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| | 02-04-2021 | ➢ THE OSI MODEL<br>▪ Layered Architecture<br>▪ Peer-to-Peer Processes | | |
| Week 8 | **Midterm Examination (05-04-2021 to 10-04-2021)** | | | |
| Week 9 | 12-04-2021 to 16-04-2021 | ➢ LAYERS IN THE OSI MODEL<br>▪ Physical Layer<br>▪ Data Link Layer<br>▪ Network Layer | Beh-Chap 2: pg. 46 | |
| | 19-04-2021 to 23-04-2021 | ▪ Transport Layer<br>▪ Session Layer<br>▪ Presentation Layer<br>▪ Application Layer<br>▪ Summary of Layers | Beh-Chap 2: pg. 62 | |
| Week 10 | 26-04-2021 to 30-04-2021 | ➢ TCP/IP PROTOCOL SUITE<br>Physical and Data Link Layers Protocols<br>▪ Network Layer Protocols<br>▪ Transport Layer Protocols | Beh-Chap 2: pg. 66 | |
| | 03-05-2021 to 07-05-2021 | ➢ ADDRESSING<br>▪ Physical Addresses<br>▪ Logical Addresses<br>▪ Port Addresses<br>▪ Specific Addresses<br>▪ Class-full and Classless addressing, Sub-netting, VLSM, CIDR | Beh-Chap 2: pg. 71 | |
| Week 11 | 10-05-2021 to 14-05-2021 | ▪ Application Layer Protocols<br>▪ HTTP<br>▪ Non-Persistent and Persistent Connections<br>▪ HTTP Message Format<br>▪ User-Server Interaction: Cookies<br>▪ Web Caching | Kurose –Ch.2 pg. 98. Wil-Chap 7: pg. 230 | |
| | 17-05-2021 to 21-05-2021 | FTP, SMTP, POP3<br>Other Protocols: ARP, EIGRP, OSPF | Kurose –Ch.2 pg. 120. Wil-Chap 2: pg. 41 | |
| Week 12 | 24-05-2021 to 28-05-2021 | **Data Link Control Protocols**<br>Flow Control<br>Error Control | Kurose –Ch.23 pg. 220. Beh-Chap 10: Pg 429, Wil-Chap 7: pg. 207 | |
| | 31-05-2021 to 04-06-2021 | High-Level Data Link Control (HDLC) | Beh-Chap 10: Pg 431. Wil-Chap 7: pg. 225 | |
| Week 13 | 12-04-2021 to 16-04-2021 | ➢ NETWORK DEVICES<br>▪ End user devices<br>▪ Network Connecting Devices<br>▪ Repeaters | Beh-Chap 11: pg. 490 | |

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|---|---|---|---|---|
| | | ▪ Hubs | | |
| | 19-04-2021 to 23-04-2021 | ▪ Bridges<br>▪ Switches<br>▪ Router<br>▪ Gateway | Beh-Chap 12: pg. 520 | |
| Week 14 | 26-04-2021 to 30-04-2021 | ➢ MULTIPLE-ACCESS PROTOCOLS<br>Network Segmentation<br>Back off Algorithms | Beh-Chap 13: pg. 600 | |
| | 03-05-2021 to 07-05-2021 | ➢ Routing Algorithms<br>Link state algorithm | Kurose –Ch. 4 pg. 322. Beh-Chap 13: pg. 602, 610 | |
| Week 15 | 10-05-2021 to 14-05-2021 | Distance vector algorithm | Kurose –Ch. 4 pg. 327. Beh-Chap 13: pg. 613 | |
| | 17-05-2021 to 21-05-2021 | Multiple Access Links and Protocols | Beh-Chap 13: pg. 615 | |
| Week 16 | 24-05-2021 to 28-05-2021 | • Switched Local Area Networks<br>• Link Virtualization: A Network as a Link Layer<br>• Data Center Networking | Kurose –Ch. 5 pg. 486. Beh-Chap 14: pg. 666 | |
| | 31-05-2021 to 04-06-2021 | Wireless and Mobile Networks<br>• Introduction<br>• Wireless Links and Network Characteristics<br>• CDMA<br>Multimedia Networks | Kurose –Ch. 6 pg. 514. Beh-Chap 14: pg. 670 | |
| **Final Examination (07-06-2021 to 19-06-2021)** | | | | |

# SIR SYED UNIVERSITY OF ENGINEERING & TECHNOLOGY
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## LAB PLAN

**Course Title: Data Communication & Networks**
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| Week No. | Lab Date | Objective | Required Reading |
|---|---|---|---|
| Week 1 | 15-02-2021 to 19-02-2021 | Data communication, networking and its topologies*types of network, implement topologies on cisco packet tracer | |
| Week 2 | 22-02-2021 to 26-02-2021 | Introduction to IOS (internetwork operating system). Implement basic commands of IOS. | |
| Week 3 | 01-03-2021 to 05-03-2021 | Study data transmission media and its type. Making Straight through cable using RJ-45 connector. | |
| Week 4 | 08-03-2021 to 12-03-2021 | Implement IP addressing & subneting on CISCO Packet Tracer. | |
| Week 5 | 15-03-2021 to 19-03-2021 | To implement different topologies on packet tracer. To study how router will configure through different networks. | |
| Week 6 | 22-03-2021 to 26-03-2021 | Implement router on a stick. Basic commands of IoS. | |
| Week 7 | 29-03-2021 to 02-04-2021 | Open ended lab | |
| Week 8 | | **Mid Term Examination (05-04-2021 to 10-04-2021)** | |
| Week 9 | 12-04-2021 to 16-04-2021 | Implementation of FTP, SMTP, POP3 in a simulator | |
| Week 10 | 19-04-2021 to 23-04-2021 | Implement DHCP server in multi vlan. Enabling DHCP server in same network. | |
| Week 11 | 26-04-2021 to 30-04-2021 | Configuring Of RIP (routing information protocol) | |
| Week 12 | 03-05-2021 to 07-05-2021 | Configuring EIGRP (enhanced interior gateway routing protocol) | |

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| Week 13 | 10-05-2021 to 14-05-2021 | Implement OSPF (open shortest path first) | |
| Week 14 | 17-05-2021 to 21-05-2021 | Configuring static routes on cisco routers.<br>configuring default route<br>To configuring of different network by using different routing protocols | |
| Week 15 | 24-05-2021 to 28-05-2021 | Implement Distance vector algorithm | |
| Week 16 | | **Lab Examination (31-05-2021 to 04-06-2021)** | |