**Nirma University**

**Institute of Technology**

**Computer Science and Engineering Department**

**Course Policy Document**

**Academic Year: 2020-21, Term: ODD**

**Semester: III-CSE**

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| **Course Code & Name** | **:** | 2CS304-Digital Communications |
| **Credit Details** | **:** | 2-1-0- 3 [ L-T-P-C ] |
| **Course Co-coordinator** | **:** | Prof. Chandan Trivedi |
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| **Course Blog/Website** | **:** | <https://lms.nirmauni.ac.in/course/view.php?id=1028> |
| **Course Faculty** | **:** | Dr. Sharada Valiveti (Division C & D)  Prof. Chandan Trivedi (Division A & B)  Prof. Parita Oza (Division D-to-D)  Prof. Umesh Bodkhe (Division C & D) |
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**Introduction to Course:**

Mankind has always communicated, but the means of communication changes. Digital communication is a mode communication where the information is encoded digitally as discrete signals and electronically transferred to the recipients. It is one of the most commonly used modes of communication now a days. Over the past century, communication technologies have had a fundamental impact on how we carry out our daily lives. Besides using the internet and mobile phones for interpersonal communication; businesses, banking, transportation systems, TV and radio broadcasts and smart power grids rely on advanced communication technology. This course will contribute to technically aware students about communication system and technology used by industry, also student can apply concept in real life to achieve expertise in communication system.

**Course Outcomes (COs):**

At the end of the course, students will be able to –

1. explain data/signal transmission over communication media
2. analyze various spread spectrum, multiplexing, and modulation techniques
3. apply concepts of data communication to solve various problems

**Syllabus:**

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| --- | --- |
| **Unit I**  **Introduction to Data Communication**: components of network, its types and topology, protocol. Network models: OSI reference model, TCP/IP protocol suite, Applications of data communications Data Communications and Networking for Today's Enterprise | 7 |
| **Unit II**  **Data and Signal:** types of Analog and digital signals and its characteristics, transmission of digital signal, data rate limits, signals in time and frequency domain, transmission impairment, performance measurement of network | 4 |
| **Unit III**  **Digital Transmission**: digital to digital and Analog to digital conversion, transmission modes, Analog transmission: Digital to analog and analog to analog conversion | 6 |
| **Unit IV**  **Multiplexing and Spread Spectrum Techniques**: Switching techniques, types of switching, structure of switch, types of switches. Telephone and cable network for data communication, dial up modem, DSL lines, Cable TV. | 5 |
| **Unit V**  **Types of Errors:** Detection versus correction, coding, block coding, cyclic codes, checksum, forward error correction. | 4 |
| **Unit VI**  **Transmission Media**: Guided media and unguided media: radio frequency allocation, frequency reuse, propagation of radio waves, micro waves and infrared, satellite communication, cellular telephony. | 4 |

**Suggested Readings^**:

1. Behrouz Forouzan, Introduction to Data Communication and Networking, Tata McGraw Hill
2. William Stallings, Data and Computer Communication, PHI
3. Schweber W.L, Data Communication, Tata McGraw Hill
4. Andrew S Tanenbaum, Computer Networks, PHI
5. B.P. Lathi, Zhi Ding, Modern Digital and Analog Communication, Oxford University Press

**Self-study:**

* Telephone and cable network for data communication
* Dial-up modem, DSL lines, Cable TV.
* Satellite communication, cellular telephony.

**Tutorial Details:**

The tutorials are planned as per the below mentioned schedule:

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| --- | --- |
| **Tutorials** | **Mapping with CO** |
| **Tutorial 1**   1. Explain different transmission modes with example. 2. Why are protocols needed? 3. What are the two types of line configuration? 4. What are the three criteria necessary for an effective and efficient network? 5. What are the advantages of distributed processing? 6. List different network topology and give advantages and disadvantages of each. 7. What are some of the factors that determine whether a communication system is a LAN or WAN? 8. For *n* devices in a network, what is the number of cable links required for a mesh,   ring, bus, and star topology?   1. For each of the following four networks, discuss the consequences if a connection fails.   a. Five devices arranged in a mesh topology  b. Five devices arranged in a star topology (not counting the hub)  c. Five devices arranged in a bus topology  d. Five devices arranged in a ring topology | **CO1** |
| **Tutorial 2**   1. Which layers in the Internet model are the network support layers? 2. Which layer in the Internet model is the user support layer? 3. What are headers and trailers, and how do they get added and removed? 4. Diifferentiate between a port address, a logical address, and a physical   address?   1. Name some services provided by the application layer in the Internet model 2. Define : peer-to-peer process? 3. Match the following to one or more layers of the OSI model:   a. Format and code conversion services  b. Establishes, manages, and terminates sessions  c. Ensures reliable transmission of data  d. Log-in and log-out procedures  e. Provides independence from differences in data representation   1. Match the following to one or more layers of the OSl model:   a. Communicates directly with user's application program  b. Error correction and retransmission  c. Mechanical, electrical, and functional interface  d. Responsibility for carrying frames between adjacent nodes  9. In given figure computer A sends a message to computer D via  LANl, router Rl, and LAN2. Show the contents of the packets and  frames at the network and data link layer for each hop interface. | **CO1** |
| **Tutorial 3**   1. How can a composite signal be decomposed into its individual frequencies? 2. Name three types of transmission impairment. 3. Distinguish between baseband transmission and broadband transmission. 4. What does the Nyquist theorem have to do with communications? 5. What does the Shannon capacity have to do with communications? 6. Is the frequency domain plot of a voice signal discrete or continuous? 7. We send a voice signal from a microphone to a recorder. Is this baseband or broadbandtransmission? 8. We send a digital signal from one station on a LAN to another station. Is this baseband or broadband transmission? 9. We modulate several voice signals and send them through the air. Is this baseband   or broadband transmission?   1. What is the bandwidth of a signal that can be decomposed into five sine waves with frequencies at 0, 20, 50, 100, and 200 Hz? All peak amplitudes are the same. Draw the spectrum. | **CO1,3** |
| **Tutorial 4**   1. A periodic composite signal with a bandwidth of 2000 Hz is composed of two sine waves. The first one has a frequency of 100 Hz with a maximum amplitude of 20 V; the second one has a maximum amplitude of 5 V. Draw the bandwidth. 2. Which signal has a wider bandwidth, a sine wave with a frequency of 100 Hz or a sine wave with a frequency of 200 Hz?   3. A device is sending out data at the rate of 1000 bps.  b. How long does it take to send out a single character ?  c. How long does it take to send a file of 100,000 characters?  4. The attenuation of a signal is -10 dB. What is the final signal power  if it was originally 5 W?  5. We measure the performance of a telephone line (4 KHz of bandwidth). When  the signal is 10 V, the noise is 5 mV. What is the maximum data rate supported  by this telephone line?   1. A file contains 2 million bytes. How long does it take to download this file   using a 56-Kbps channel? 1-Mbps channel? | **CO1,3** |
| **Tutorial 5**   1. Distinguish between a signal element and a data element. 2. Distinguish between data rate and signal rate. 3. Define a DC component and its effect on digital transmission. 4. Calculate the value of the signal rate for each of following case if the data rate is 1 Mbps and c = 1/2. 5. 1 signal element, 1 data element 6. 2 signal element, 1 data element 7. 1 signal element, 2 data element 8. 3 signal element, 4 data element 9. Draw the graph of the NRZ-L and NRZ-I scheme using each of the following data streams.   a. 00000000 b. 11111111  c. 01010101 d. 00110011  6. Repeat Exercise 5 for 2B 1Q scheme, using following data streams.  a. 0000000000000000 b. 1111111111111111  c. 0101010101010101 d. 0011001100110011  7. Repeat Exercise 5 for the MLT-3 scheme, using following data  streams.  a. 00000000 b. 11111111  c. 01010101 d. 00011000 | **CO2** |
| **Tutorial 6**   1. We have a baseband channel with a I-MHz bandwidth. What is the data rate for this channel if we use one of the following line coding schemes?   a. NRZ-L b. Manchester  c. MLT-3 d. 2B1Q  2. Apply MLT-3 scheme on following data streams.  a. 00000000 b. 11111111  c. 01010101 d. 00011000  3. What is the result of scrambling the sequence 11100000000000 using one  of the following scrambling techniques? Assume that the last non-zero  signal level has been positive.  a. B8ZS  b. HDB3 (The number of nonzero pules is odd after the last substitution)  4. What is the number of bits per baud for the following techniques?  a. ASK with four different amplitudes  b. FSK with 8 different frequencies  c. PSK with four different phases  d. QAM with a constellation of 128 points  5. Draw the constellation diagram for the following:  a. BPSK, with a peak amplitude value of 2  b. QPSK, with a peak amplitude value of 3  c. 8-QAM with two different peak amplitude values, I and 3, and four  different phases.   1. Assume that sampled signal consists of the amplitudes ranging from -20 V to +20 V if 8 quantization levels are used. Find out normalized PAM values, quantized error and quantized code for given samples.  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Time | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | | Amplitude | -6.2 | 6.1 | 14.2 | 18.3 | 10.0 | -5.4 | -7.6 | -8.2 | | **CO2** |
| **Tutorial 7**   1. Distinguish between multilevel TDM, multiple slot TDM, and pulse-   stuffed TDM.   1. Distinguish between synchronous and statistical TDM. 2. Distinguish between a link and a channel in multiplexing. 3. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth 4. There are 4 stations A, B, C and D that transmits 1, 0, 1 and 1 respectively. Assume user D is listening to user B and user A is listening to user C. By taking appropriate parameters show the process of reception of data for both stations D and A. | **CO2** |
| **Tutorial 8**  Q1: Give an example to show how hamming distance can be used to deduce the correct code (i.e. original code from the sender) for a received, damaged code.  Q2: What is the Hamming distance for each of the following codewords:   1. d(10000, 00000) 2. d(10101, 10000) 3. d(11111,11111) 4. d(000,000)   Q3: Given the dataword 1010011110 and the divisor 10111,   1. Show the generation of the codeword at the sender site (using binary division). 2. Show the checking of the codeword at the receiver site (assume no error).   Q4: In Table 1, the sender sends dataword 10. A 3-bit burst error corrupts the codeword. Can the receiver detect the error? Define your answer.    Table 1  Q5: Prove that the code represented by Table 2 is not linear code. You need to find only one case that violates the linearity.  Table 2  Q6: This problem shows a special case in checksum handling. A sender has two data items to send: 0x4567 and 0xBA98. What is the value of the checksum? | **CO1,3** |
| **Tutorial 9**  Q1: Find the suitability of the following generators in relation to burst errors of different lengths.   1. (x6 + 1) 2. (x18 + x7 + x + 1) 3. (x32 + x23 + x7 + 1)   Q2 Can the value of a checksum be all 0s (in binary) ? Defend your answer. Can the value be all 1s (in binary) ? Defend your answer.  Q3: We need a dataword of at least 11 bits. Find the values of k and n in the Hamming code C(n,k) with dmin = 3.  Q4: Apply the following operations on the corresponding polynomials:   1. (x3 + x2 + x + 1) + ( x3 + x2 + x + 1) 2. (x3 + x2 + x + 1) - ( x3 + x2 + x + 1) 3. (x3 + x2) \* ( x4 + x2 + x + 1) 4. (x3 + x2 + x + 1) / ( x2 + 1)   Q5: What kind of arithmetic is used to add data items in checksum calculation? What kind of error is undetectable by the checksum?  Q6: Assuming even parity, find the parity bit for each of the following data units.   1. 1001011 2. 0001100 3. 1000000 4. 1110111 | **CO1,3** |
| **Tutorial 10**   1. Using Figure tabulate the attenuation (in dB) of a 18-gauge UTP for the indicated frequencies and distances.      1. How does sky propagation differ from line-of-sight propagation? 2. If the power at the beginning of a 1 Km 18-gauge UTP is 200 mw, what is the power at the end for frequencies 1 KHz, 10 KHz, and 100 KHz? Use the result of Exercise 1. 3. Using table given below tabulate the attenuation (in dB) of a 2.6/9.5 mm coaxial cable for the indicated frequencies and distances.        1. If the power at the beginning of a 1 Km 2.6/9.5 mm coaxial cable is 200 mw, what is the power at the end for frequencies 1 KHz, 10 KHz, and 100 KHz? Use the result of Exercise 4 2. Calculate the bandwidth of the light for the following wavelength ranges (assume a propagation speed of 2 x 108 m):    1. 1000 to 1200 nm    2. 1000 to 1400 nm 3. A beam of light moves from one medium to another medium with less density. The critical angle is 60°. Do we have refraction or reflection for each of the following incident angles? Show the bending of the light ray in each case.    1. 40°    2. 60°    3. 80° | **CO1** |

**Component wise Continuous Evaluation & Semester End Examination weightage:**

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| --- | --- | --- | --- | --- |
| **Component** | **Continuous Evaluation** | | | **SEE** |
| **Component weightage** | 0.6 | | | 0.4 |
|  | Quizzes(3)  30% | Assignments (2)  30% | Comprehensive Evaluation  40% |  |

**Lesson Plan:**

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| **Sr. No** | **Topics** | **Hour(s)** | **CLO Mapping** | **Applications** |
| **1** | **Unit I**  Introduction to Data Communication:   * Introduction to Course and Policy, Need and effectiveness of communication Components of network, its type * Topology, protocols and Need of layered architecture * OSI reference model * TCP/IP protocol suite, * Applications and Data Communications and Networking for Today's Enterprise * Doubt Solving Session | [7]  1  1  2  1  1  1 | CO 1 | Network design,Network programming |
| **2** | **Unit II**  Data and Signal:   * Types of Analog and digital signals and its characteristics * Transmission of digital signal, data rate limits, signals in time and frequency domain * Transmission impairment, performance measurement of network * Doubt solving session | [6]  1  2  2  1 | CO1,  CO3 | Network Design and troubleshooting, Noise Removal |
| **3** | **Unit III**  Digital Transmission:   * Digital Transmission: Digital to digital and Analog to digital conversion, Transmission modes * Analog transmission: Digital to analog and analog to analog conversion * Doubt solving session | [8]  3  4  1 | CO2 | Digital Data Transmission, Radio and TV Broadcasting |
| **4** | **Unit IV**  Multiplexing and Spread Spectrum Techniques:   * Pseudo-Noise Sequence & DS Spread Spectrum * FH Spread Spectrum * Multiple Access Techniques: TDMA, FDAM, CDMA * Switching Techniques, types of switching, structure of switch, types of switches * Doubt Solving session | [8]  2  1  2  2  1 | CO2 | Privacy of data, Anti-jamming |
| **5** | **Unit V**  Error Detection and Correction :   * Detection versus correction, coding, block coding * Cyclic codes, checksum, forward error correction. * Doubt Solving Session | [8]  3  4  1 | CO1,3 | Error Detection & Correction in Transmission |
| **6** | **Unit VI**  Transmission Media:   * Guided media * Unguided media * Doubt Solving Session   Revision of whole syllabus and Doubt solving and Practice numerical | [5]  2  2  1  [3] | CO1 | Home and College Network |

**Course Assessment Schemes**

**Continuous Evaluation**: Quizzes, Assignments, Comprehensive Assesment

**Semester End Evaluation**: Semester End Examination (SEE)

**Teaching-learning methodology:**

* Use of Black board, PPT, Discussion and Videos etc.

**Active learning techniques**

* Short Quiz after completion of Chapter
* One Minute Paper

**Course Material:**

Following material available on course website:

Moodle: <https://lms.nirmauni.ac.in/course/view.php?id=1028>

Google Site: <https://sites.google.com/a/nirmauni.ac.in/2cs304-digital-communications/>

* Course Policy
* PPTs, Notes, other Material
* [Assignments, Tutorials](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/j-assignments-tutorials)
* Question bank
* [Web-links](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/m-course-related-important-web-links), [Moodle](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/n-course-related-own-blog-and-other-such-blogs) link, [Video Lectures](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/o-video-lectures-if-available-like-nptel-mooc-etc), [Journals](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/p-list-of-international-national-journals-related-to-the-course)
* [Animations /Simulations](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/x-animations-simulations-to-explain-the-complex-principles), [Software’s](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/y-useful-softwares)
* [Advanced topics](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/q-list-of-advanced-topics-seminar-topics-related-to-the-course)
* Industries/[Organizations](https://sites.google.com/a/nirmauni.ac.in/3ec1218-testing-and-verification-of-vlsi-design/home/academic-docs/r-list-of-world-leading-industries-organizations-working-on-the-course-related-areas)

**Course Outcome Attainment:**

* Use of formal evaluation components of continuous evaluation, Tutorials, semester end examination
* Informal feedback during course conduction